

APPENDIX 8E: AVERAGE TRANSFORMER DESIGN PROPERTIES FROM LIFE-CYCLE COST MODEL

TABLE OF CONTENTS

8E.1	INTRODUCTION	8E-1
8E.2	CORRECTION TO FEDERAL REGISTER NOTICE AND TSD CHAPTER 8	8E-1
8E.3	TABLES OF AVERAGE TRANSFORMER DESIGN PROPERTIES	8E-2
8E.4	HISTOGRAMS OF TRANSFORMER DESIGN EFFICIENCIES	8E-7

LIST OF TABLES

Table 8E.3.1	Average LCC Transformer Design Properties for Design Line 1 Representative Unit	8E-2
Table 8E.3.2	Average LCC Transformer Design Properties for Design Line 2 Representative Unit	8E-2
Table 8E.3.3	Average LCC Transformer Design Properties for Design Line 3 Representative Unit	8E-2
Table 8E.3.4	Average LCC Transformer Design Properties for Design Line 4 Representative Unit	8E-3
Table 8E.3.5	Average LCC Transformer Design Properties for Design Line 5 Representative Unit	8E-3
Table 8E.3.6	Average LCC Transformer Design Properties for Design Line 6 Representative Unit	8E-3
Table 8E.3.7	Average LCC Transformer Design Properties for Design Line 7 Representative Unit	8E-4
Table 8E.3.8	Average LCC Transformer Design Properties for Design Line 8 Representative Unit	8E-4
Table 8E.3.9	Average LCC Transformer Design Properties for Design Line 9 Representative Unit	8E-4
Table 8E.3.10	Average LCC Transformer Design Properties for Design Line 10 Representative Unit	8E-5
Table 8E.3.11	Average LCC Transformer Design Properties for Design Line 11 Representative Unit	8E-5
Table 8E.3.12	Average LCC Transformer Design Properties for Design Line 12 Representative Unit	8E-5
Table 8E.3.13	Average LCC Transformer Design Properties for Design Line 13 Representative Unit	8E-6

LIST OF FIGURES

Figure 8E.4.2	Distribution of Efficiencies for Design Line 1 Representative Unit, Baseline	8E-7
Figure 8E.4.2	Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 1	8E-7
Figure 8E.4.3	Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 2	8E-8
Figure 8E.4.4	Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 3	8E-8
Figure 8E.4.5	Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 4	8E-9
Figure 8E.4.6	Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 5	8E-9
Figure 8E.4.7	Distribution of Efficiencies for Design Line 2 Representative Unit, Baseline	8E-10
Figure 8E.4.8	Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 1	8E-10
Figure 8E.4.9	Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 2	8E-11
Figure 8E.4.10	Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 3	8E-11
Figure 8E.4.11	Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 4	8E-12
Figure 8E.4.12	Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 5	8E-12
Figure 8E.4.13	Distribution of Efficiencies for Design Line 3 Representative Unit, Baseline	8E-13
Figure 8E.4.14	Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 1	8E-13
Figure 8E.4.15	Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 2	8E-14
Figure 8E.4.16	Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 3	8E-14
Figure 8E.4.17	Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 4	8E-15
Figure 8E.4.18	Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 5	8E-15
Figure 8E.4.19	Distribution of Efficiencies for Design Line 4 Representative Unit, Baseline	8E-16
Figure 8E.4.20	Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 1	8E-16

Figure 8E.4.21	Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 2	8E-17
Figure 8E.4.22	Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 3	8E-17
Figure 8E.4.23	Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 4	8E-18
Figure 8E.4.24	Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 5	8E-18
Figure 8E.4.25	Distribution of Efficiencies for Design Line 5 Representative Unit, Baseline	8E-19
Figure 8E.4.26	Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 1	8E-19
Figure 8E.4.27	Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 2	8E-20
Figure 8E.4.28	Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 3	8E-20
Figure 8E.4.29	Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 4	8E-21
Figure 8E.4.30	Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 5	8E-21
Figure 8E.4.31	Distribution of Efficiencies for Design Line 6 Representative Unit, Baseline	8E-22
Figure 8E.4.32	Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 1	8E-22
Figure 8E.4.33	Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 2	8E-23
Figure 8E.4.34	Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 3	8E-23
Figure 8E.4.35	Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 4	8E-24
Figure 8E.4.36	Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 5	8E-24
Figure 8E.4.37	Distribution of Efficiencies for Design Line 7 Representative Unit, Baseline	8E-25
Figure 8E.4.38	Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 1	8E-25
Figure 8E.4.39	Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 2	8E-26
Figure 8E.4.40	Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 3	8E-26
Figure 8E.4.41	Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 4	8E-27

Figure 8E.4.42	Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 5	8E-27
Figure 8E.4.43	Distribution of Efficiencies for Design Line 8 Representative Unit, Baseline	8E-28
Figure 8E.4.44	Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 1	8E-28
Figure 8E.4.45	Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 2	8E-29
Figure 8E.4.46	Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 3	8E-29
Figure 8E.4.47	Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 4	8E-30
Figure 8E.4.48	Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 5	8E-30
Figure 8E.4.49	Distribution of Efficiencies for Design Line 9 Representative Unit, Baseline	8E-31
Figure 8E.4.50	Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 1	8E-31
Figure 8E.4.51	Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 2	8E-32
Figure 8E.4.52	Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 3	8E-32
Figure 8E.4.53	Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 4	8E-33
Figure 8E.4.54	Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 5	8E-33
Figure 8E.4.55	Distribution of Efficiencies for Design Line 10 Representative Unit, Baseline	8E-34
Figure 8E.4.56	Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 1	8E-34
Figure 8E.4.57	Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 2	8E-35
Figure 8E.4.58	Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 3	8E-35
Figure 8E.4.59	Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 4	8E-36
Figure 8E.4.60	Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 5	8E-36
Figure 8E.4.61	Distribution of Efficiencies for Design Line 11 Representative Unit, Baseline	8E-37
Figure 8E.4.62	Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 1	8E-37

Figure 8E.4.63	Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 2	8E-38
Figure 8E.4.64	Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 3	8E-38
Figure 8E.4.65	Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 4	8E-39
Figure 8E.4.66	Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 5	8E-39
Figure 8E.4.67	Distribution of Efficiencies for Design Line 12 Representative Unit, Baseline	8E-40
Figure 8E.4.68	Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 1	8E-40
Figure 8E.4.69	Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 2	8E-41
Figure 8E.4.70	Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 3	8E-41
Figure 8E.4.71	Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 4	8E-42
Figure 8E.4.72	Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 5	8E-42
Figure 8E.4.73	Distribution of Efficiencies for Design Line 12 Representative Unit, Baseline	8E-43
Figure 8E.4.74	Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 1	8E-43
Figure 8E.4.75	Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 2	8E-44
Figure 8E.4.76	Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 3	8E-44
Figure 8E.4.77	Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 4	8E-45
Figure 8E.4.78	Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 5	8E-45

APPENDIX 8E: AVERAGE TRANSFORMER DESIGN PROPERTIES FROM LIFE-CYCLE COST MODEL

8E.1 INTRODUCTION

In this supplementary Technical Support Document (TSD) appendix, the Department provides additional information regarding the Advance Notice of Proposed Rulemaking Life-Cycle Cost (LCC) calculation results. At the September 28, 2004 public meeting, stakeholders requested the following specific information from the LCC analysis: the average efficiency and average costs and prices for the baseline and each of the five candidate standard levels for the thirteen representative units analyzed.

8E.2 CORRECTION TO FEDERAL REGISTER NOTICE AND TSD CHAPTER 8

In developing its response to this stakeholder request, the Department learned that in both the July 29, 2004 Federal Register Notice and the TSD Chapter 8, the consumer equipment cost before installation was mis-labeled as the average manufacturer's selling price. The consumer equipment cost before installation represents a marked-up cost, specifically the manufacturer's selling price plus shipping, taxes, and distribution chain markups. This mis-labeling affects text in the Federal Register Notice section II.F.4 (pages 45401 through 45404) and TSD Chapter 8, section 8.4 on pages 8-38 through 8-43. However, it is important to note that the mis-labeling of these values does not change the inputs to the ANOPR LCC nor the results shown in the ANOPR LCC or National Impacts Analysis.

This new Appendix 8E correctly provides the average manufacturer's selling price, the average installed cost (consumer equipment cost plus installation) and other important attributes for each of the thirteen distribution transformers analyzed.

8E.3 TABLES OF AVERAGE TRANSFORMER DESIGN PROPERTIES

Table 8E.3.1 Average LCC Transformer Design Properties for Design Line 1 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	1,333	1,376	1,432	1,707	1,962	2,231
Installed Cost (\$)	3,054	3,103	3,197	3,620	3,890	4,311
Efficiency at 50% Load (%)	98.9	99.1	99.2	99.3	99.5	99.6
Core Loss (W)	168.3	138.3	127.5	87.4	42.8	42.0
Coil Loss at 50% Load (W)	100.7	96.2	84.9	79.8	83.1	61.6
Weight (lbs)	821	824	859	993	993	1,142

Table 8E.3.2 Average LCC Transformer Design Properties for Design Line 2 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	819	845	911	1,057	1,289	1,484
Installed Cost (\$)	2,019	2,047	2,163	2,426	2,761	3,092
Efficiency at 50% Load (%)	98.6	98.8	98.9	99.1	99.4	99.5
Core Loss (W)	117.4	95.5	86.3	64.6	28.3	30.4
Coil Loss at 50% Load (W)	56.6	55.3	48.5	47.1	49.9	34.3
Weight (lbs)	408	408	441	524	598	707

Table 8E.3.3 Average LCC Transformer Design Properties for Design Line 3 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	3,899	4,179	4,493	6,791	7,565	9,205
Installed Cost (\$)	7,014	7,372	7,749	10,511	11,562	13,728
Efficiency at 50% Load (%)	99.3	99.4	99.5	99.7	99.7	99.8
Core Loss (W)	753.7	663.3	580.5	170.9	186.8	233.2
Coil Loss at 50% Load (W)	924.1	845.4	768.0	710.0	538.4	375.6
Weight (lbs)	2,388	2,480	2,545	3,071	3,456	4,219

Table 8E.3.4 Average LCC Transformer Design Properties for Design Line 4 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	3,110	3,344	3,554	4,512	4,529	5,222
Installed Cost (\$)	5,457	5,714	6,030	7,203	7,233	8,221
Efficiency at 50% Load (%)	98.9	99.1	99.2	99.5	99.5	99.6
Core Loss (W)	503.0	382.5	326.8	135.0	134.0	150.8
Coil Loss at 50% Load (W)	364.7	330.8	295.3	282.0	266.6	175.9
Weight (lbs)	1,403	1,416	1,527	1,734	1,749	2,100

Table 8E.3.5 Average LCC Transformer Design Properties for Design Line 5 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	9,376	9,990	10,848	13,790	16,658	20,029
Installed Cost (\$)	14,687	15,526	16,619	20,410	23,317	27,531
Efficiency at 50% Load (%)	99.3	99.4	99.5	99.5	99.6	99.7
Core Loss (W)	1,788.2	1,737.3	1,552.4	1,313.4	595.3	600.3
Coil Loss at 50% Load (W)	3,355.9	2,885.1	2,633.3	2,269.0	2,301.5	1,822.0
Weight (lbs)	5,740	6,112	6,491	7,966	7,704	9,183

Table 8E.3.6 Average LCC Transformer Design Properties for Design Line 6 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	519	611	673	680	778	836
Installed Cost (\$)	1,688	1,834	1,940	1,942	2,149	2,278
Efficiency at 35% Load (%)	95.4	98.1	98.5	98.5	98.7	98.8
Core Loss (W)	332.6	92.5	71.9	65.6	50.4	49.2
Coil Loss at 35% Load (W)	87.5	74.1	66.1	66.1	63.4	56.8
Weight (lbs)	231	231	236	232	261	282

Table 8E.3.7 Average LCC Transformer Design Properties for Design Line 7 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	1,077	1,155	1,223	1,333	1,591	2,027
Installed Cost (\$)	3,008	3,079	3,216	3,421	3,925	4,793
Efficiency at 35% Load (%)	96.6	98.2	98.4	98.7	98.9	99.1
Core Loss (W)	730.3	298.4	233.0	170.3	129.2	141.7
Coil Loss at 35% Load (W)	212.4	188.1	182.5	173.6	158.7	93.8
Weight (lbs)	525	486	509	533	614	778

Table 8E.3.8 Average LCC Transformer Design Properties for Design Line 8 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	2,774	2,915	3,023	3,488	4,030	4,379
Installed Cost (\$)	6,794	7,010	7,216	7,994	8,955	9,541
Efficiency at 35% Load (%)	97.9	98.8	98.9	99.1	99.2	99.3
Core Loss (W)	1,649.9	795.6	743.6	493.8	407.8	381.5
Coil Loss at 35% Load (W)	627.0	493.0	477.2	493.9	419.4	382.1
Weight (lbs)	1,693	1,688	1,735	1,800	1,947	1,998

Table 8E.3.9 Average LCC Transformer Design Properties for Design Line 9 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	3,619	3,855	4,286	4,636	5,555	6,644
Installed Cost (\$)	8,199	8,569	9,323	9,894	11,568	13,557
Efficiency at 50% Load (%)	98.1	98.7	98.9	99.0	99.2	99.3
Core Loss (W)	1,829.1	922.6	787.6	575.9	582.4	557.3
Coil Loss at 50% Load (W)	1,125.2	1,058.1	955.6	899.4	607.0	472.5
Weight (lbs)	1,799	1,801	1,903	1,933	2,256	2,667

Table 8E.3.10 Average LCC Transformer Design Properties for Design Line 10 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	13,406	16,821	17,404	19,314	23,223	25,493
Installed Cost (\$)	26,414	32,514	33,592	36,391	43,233	47,172
Efficiency at 50% Load (%)	98.8	99.2	99.2	99.3	99.4	99.5
Core Loss (W)	4,237.5	3,463.2	3,252.3	2,500.7	2,552.2	2,357.7
Coil Loss at 50% Load (W)	5,162.7	2,879.9	2,684.9	2,745.0	1,919.8	1,816.7
Weight (lbs)	6,706	8,260	8,614	8,209	9,781	10,651

Table 8E.3.11 Average LCC Transformer Design Properties for Design Line 11 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	6,028	6,935	7,315	8,042	8,990	9,794
Installed Cost (\$)	12,881	14,332	14,996	16,336	18,017	19,443
Efficiency at 50% Load (%)	98.0	98.6	98.7	98.9	99.0	99.1
Core Loss (W)	1,530.6	988.6	929.9	897.5	897.2	751.4
Coil Loss at 50% Load (W)	1,462.7	1,167.0	986.3	740.7	564.7	585.7
Weight (lbs)	3,113	3,159	3,271	3,598	3,931	4,220

Table 8E.3.12 Average LCC Transformer Design Properties for Design Line 12 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	15,820	18,097	18,962	22,154	25,544	28,695
Installed Cost (\$)	30,567	34,221	36,076	41,259	47,092	52,597
Efficiency at 50% Load (%)	98.8	99.1	99.2	99.3	99.4	99.5
Core Loss (W)	4,092.8	2,699.8	3,650.0	2,380.0	2,329.3	2,108.1
Coil Loss at 50% Load (W)	4,910.2	4,509.6	2,747.5	2,795.2	2,167.2	2,018.5
Weight (lbs)	7,466	7,653	8,714	9,118	10,288	11,602

Table 8E.3.13 Average LCC Transformer Design Properties for Design Line 13 Representative Unit

	Candidate Standard Level					
	Base	1	2	3	4	5
Manufacturer Selling Price (\$)	22,198	23,969	26,715	31,912	33,815	42,484
Installed Cost (\$)	41,847	44,879	49,096	58,320	61,257	76,952
Efficiency at 50% Load (%)	98.9	99.1	99.2	99.3	99.4	99.5
Core Loss (W)	6,331.7	4,400.0	3,926.2	3,941.2	3,069.0	3,295.7
Coil Loss at 50% Load (W)	5,332.8	5,163.6	4,374.0	2,897.9	2,939.1	2,205.6
Weight (lbs)	10,275	10,867	10,686	13,230	13,130	18,446

8E.4 HISTOGRAMS OF TRANSFORMER DESIGN EFFICIENCIES

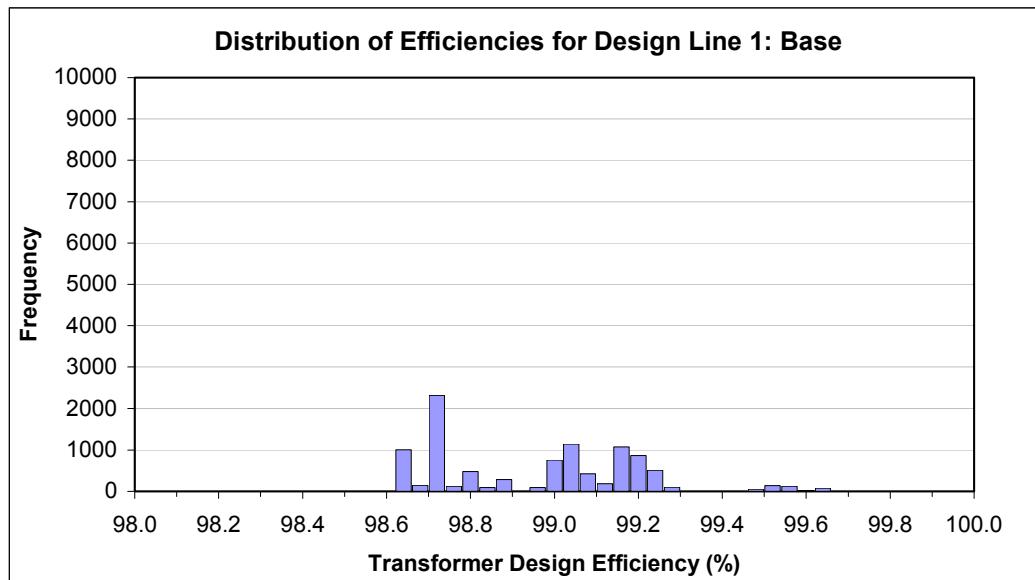


Figure 8E.4.2 Distribution of Efficiencies for Design Line 1 Representative Unit, Baseline

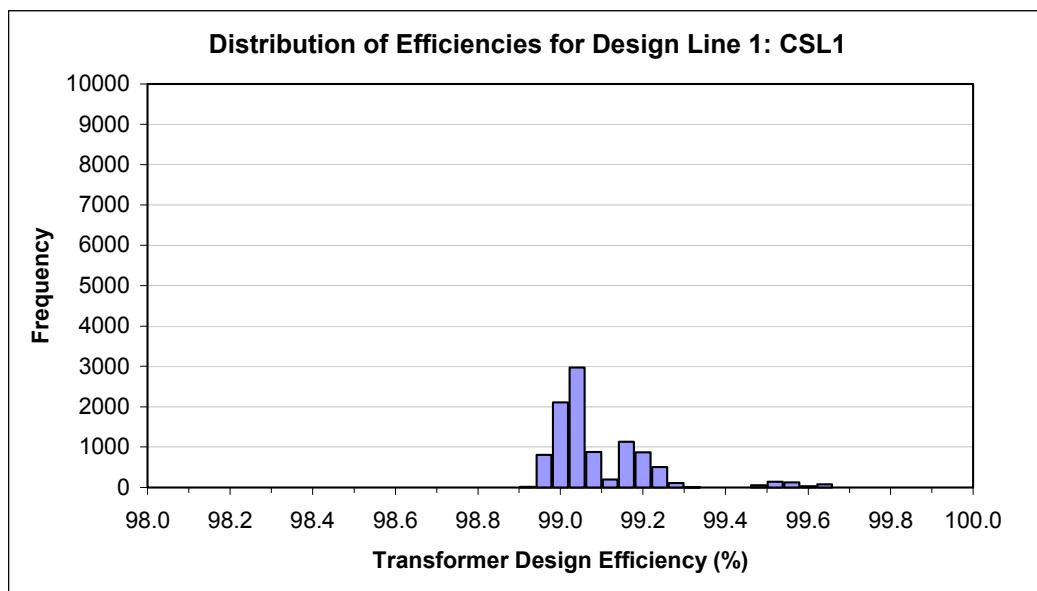


Figure 8E.4.2 Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 1

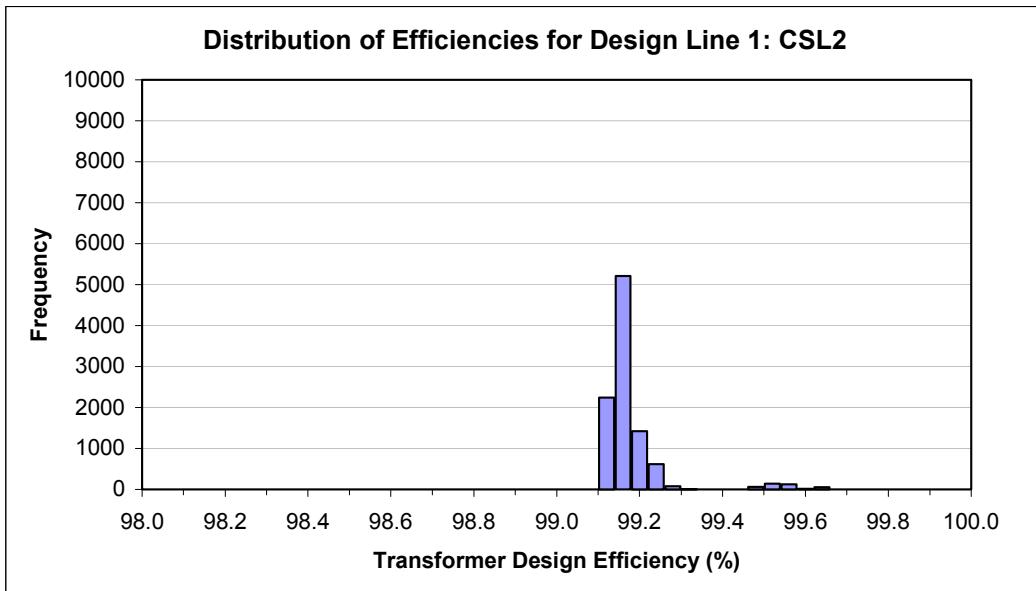


Figure 8E.4.3 Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 2

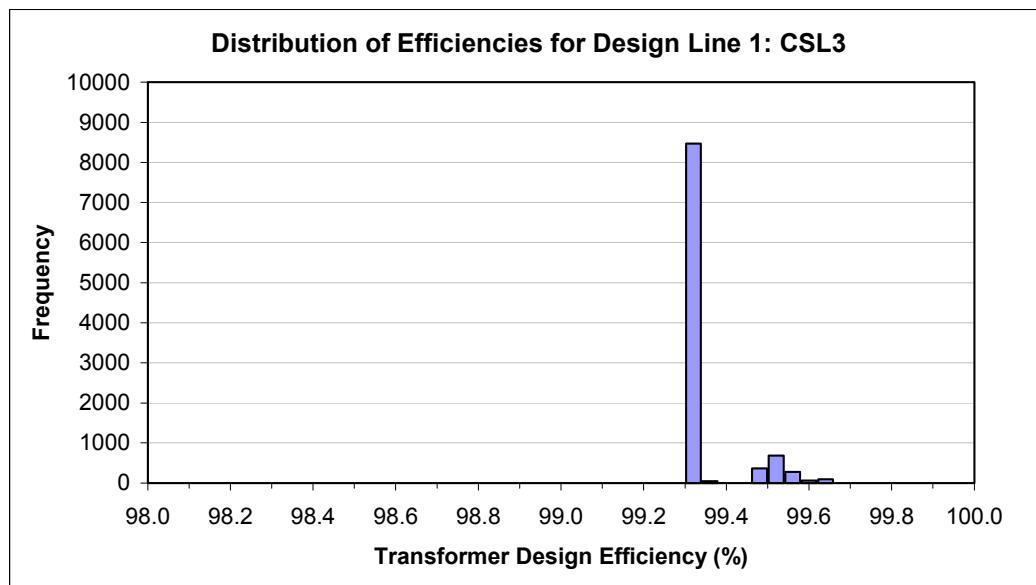


Figure 8E.4.4 Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 3

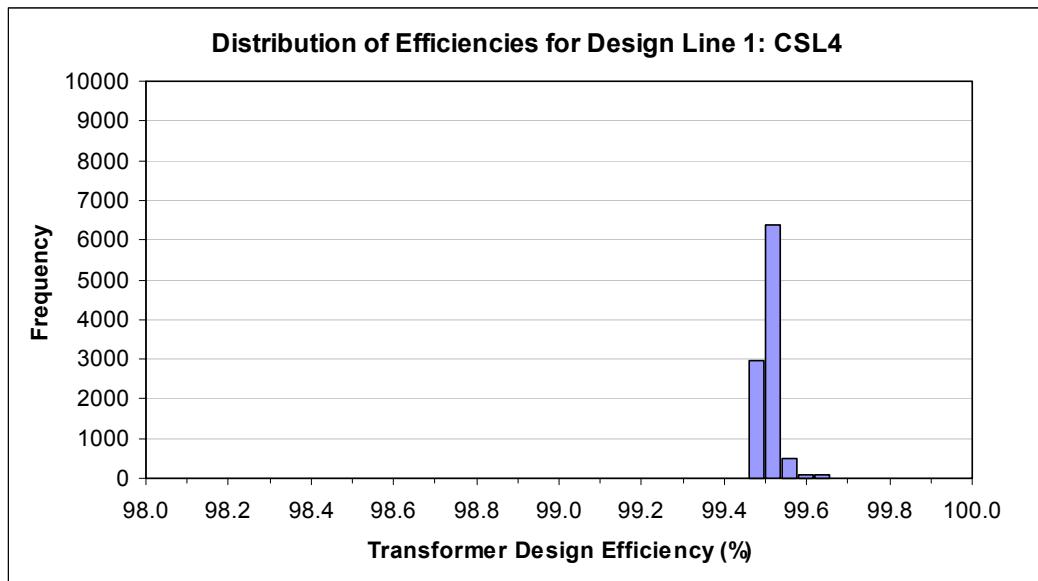


Figure 8E.4.5 Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 4

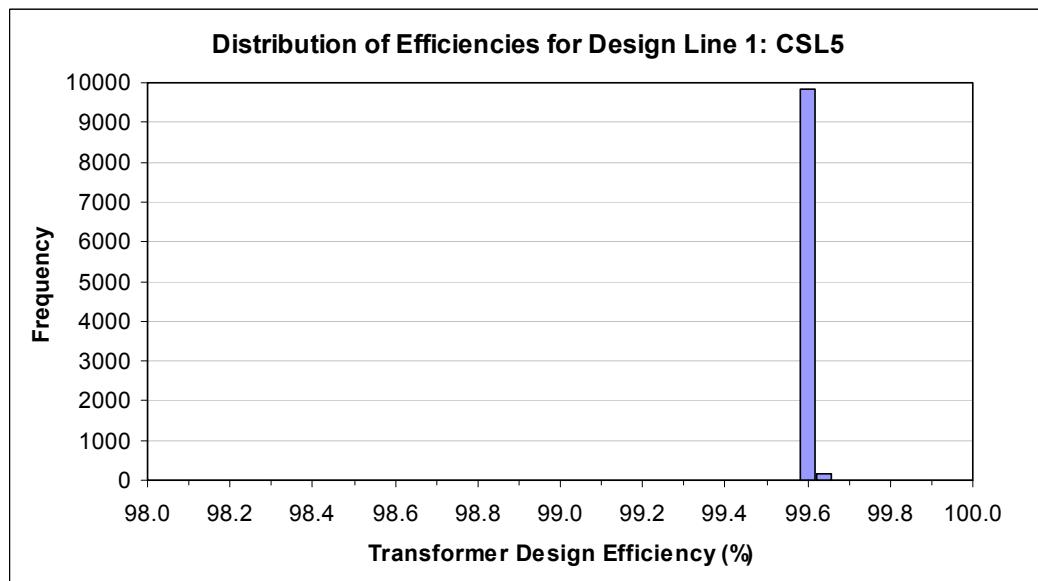


Figure 8E.4.6 Distribution of Efficiencies for Design Line 1 Representative Unit, CSL 5

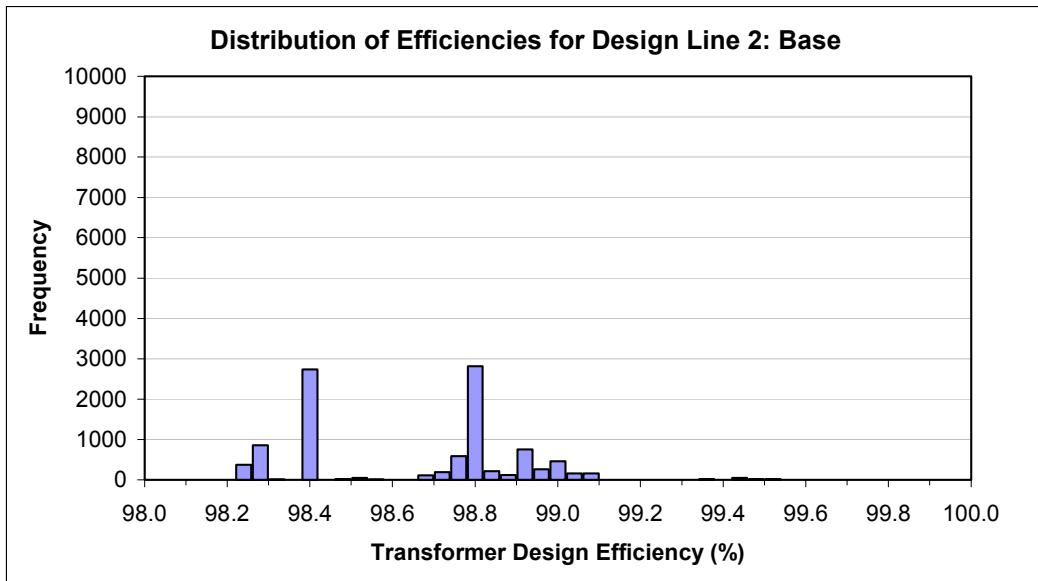


Figure 8E.4.7 Distribution of Efficiencies for Design Line 2 Representative Unit, Baseline

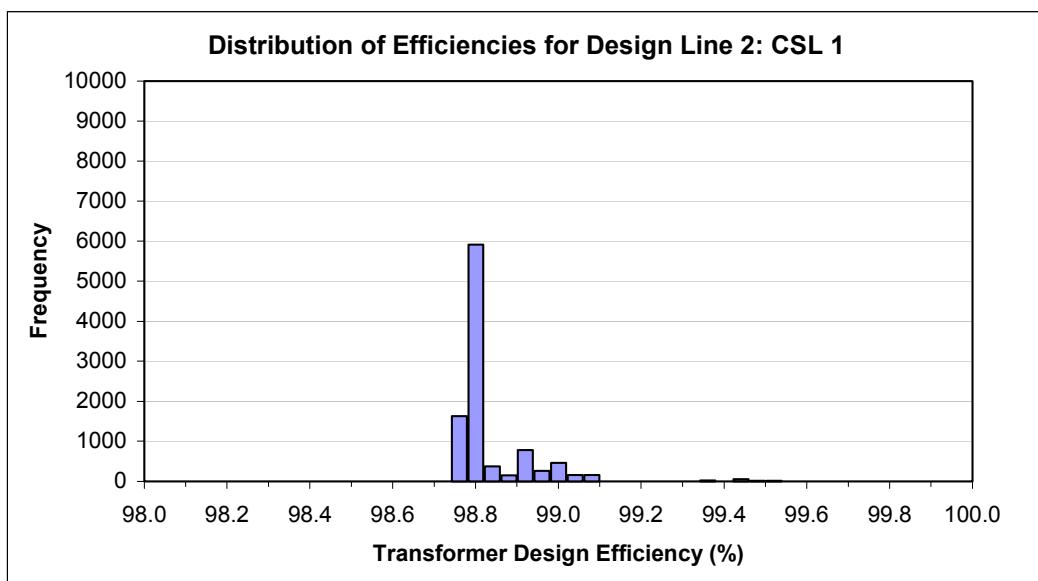


Figure 8E.4.8 Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 1

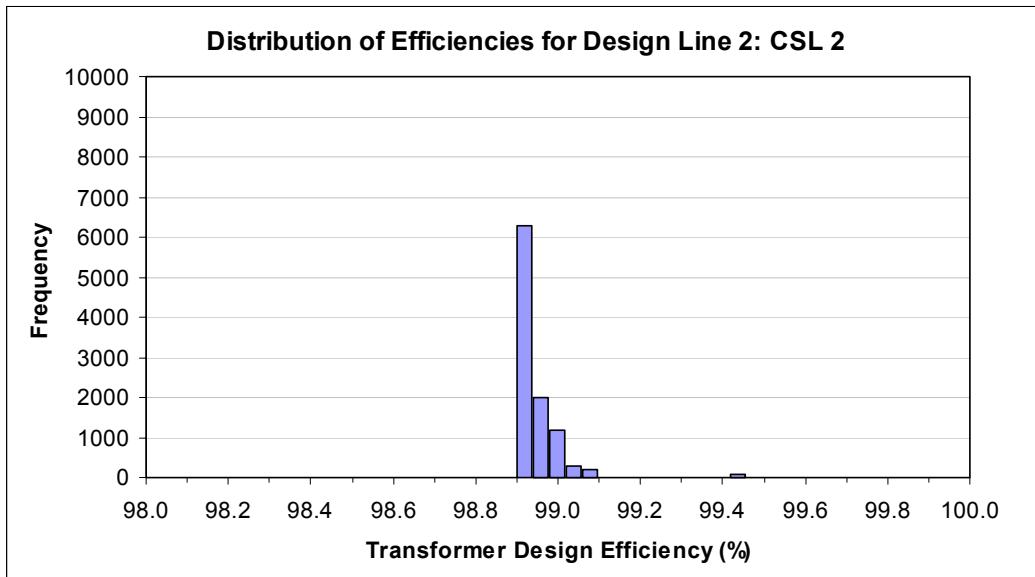


Figure 8E.4.9 Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 2

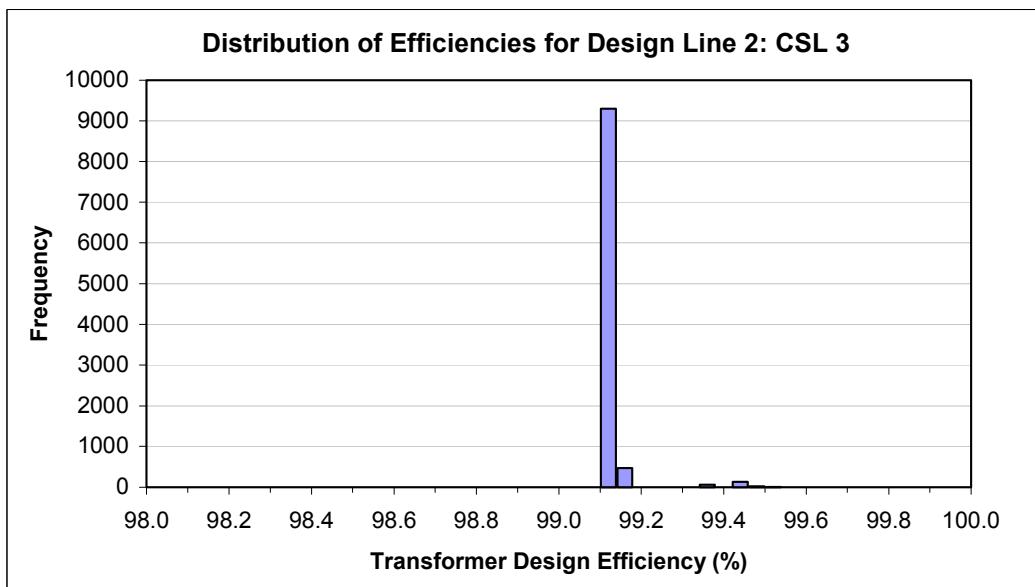


Figure 8E.4.10 Distribution of Efficiencies for Design Line 2 Representative Unit, CSL 3

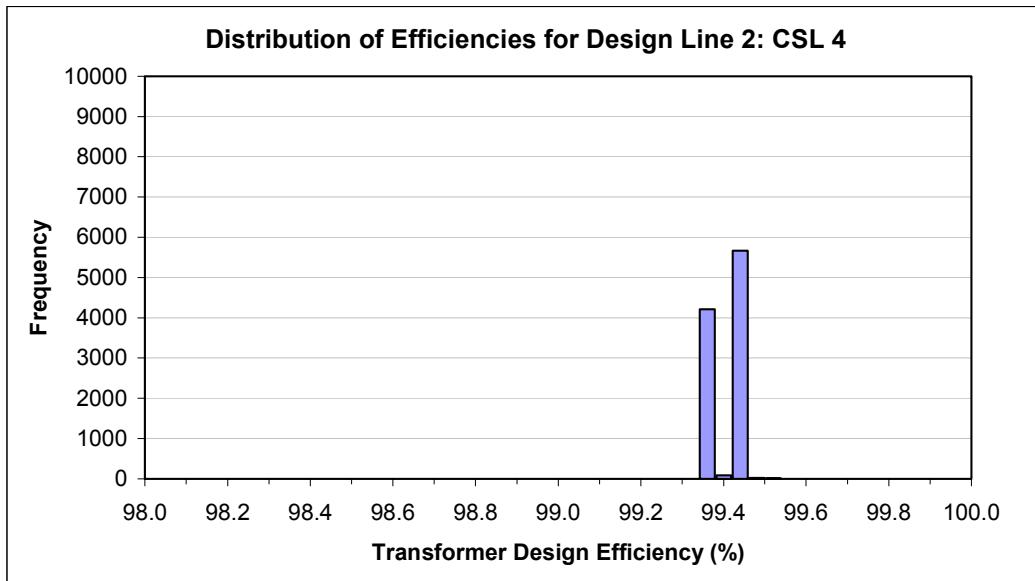


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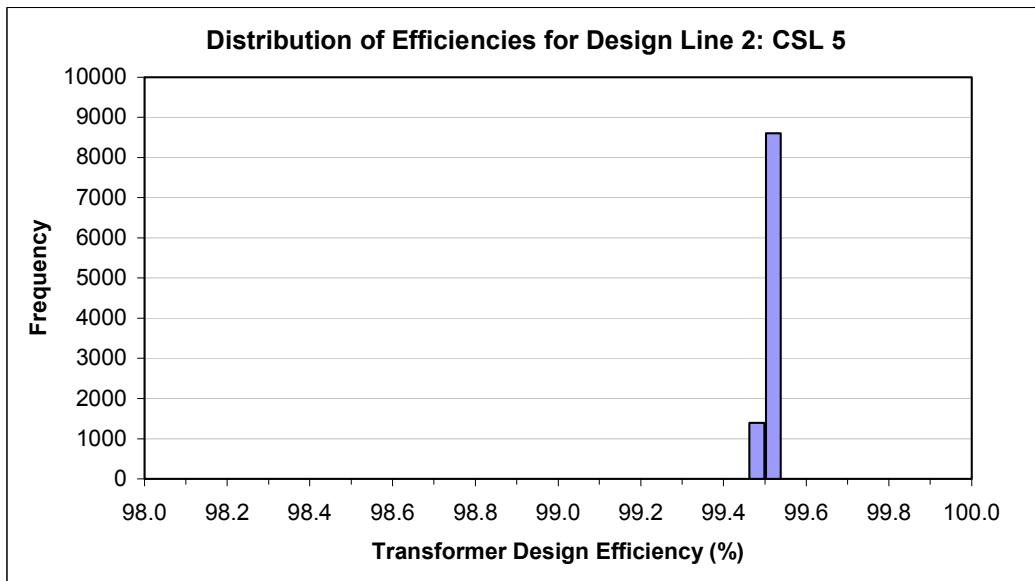


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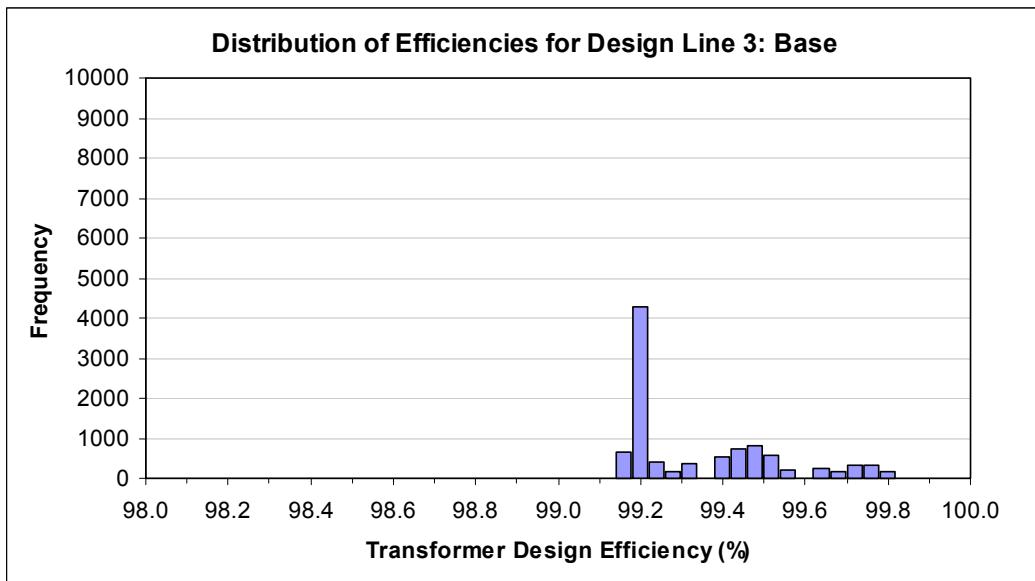


Figure 8E.4.13 Distribution of Efficiencies for Design Line 3 Representative Unit, Baseline

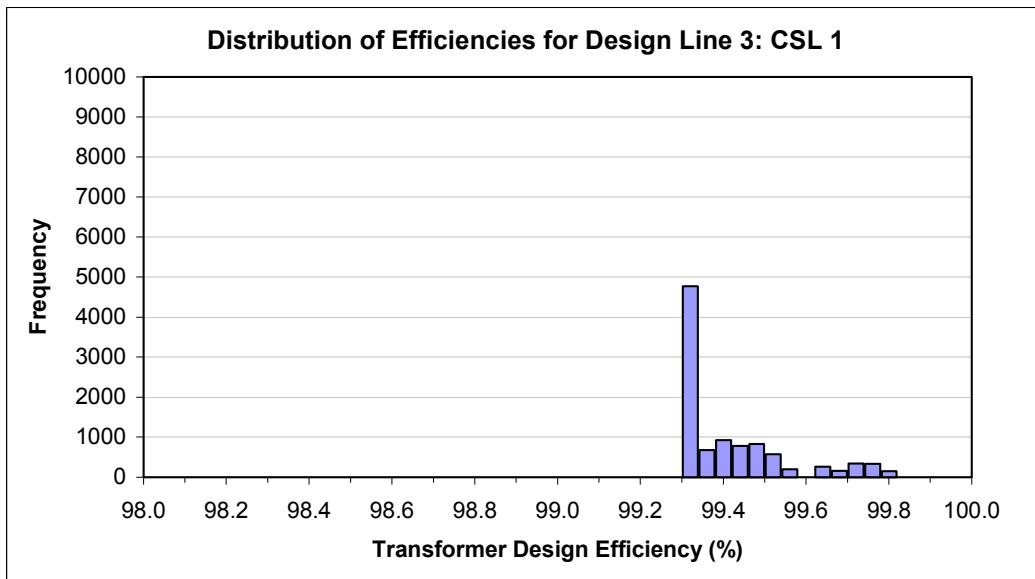


Figure 8E.4.14 Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 1

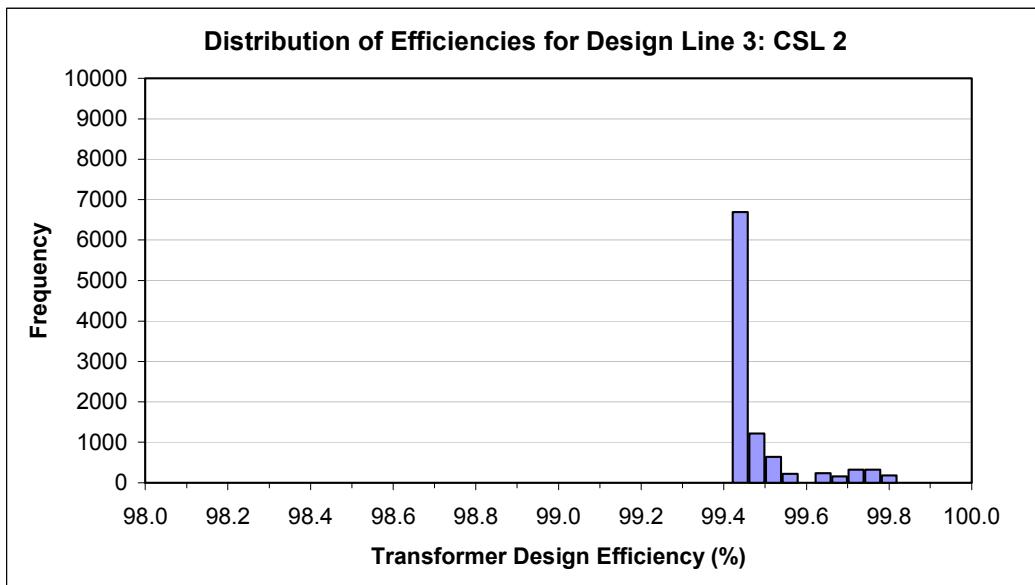


Figure 8E.4.15 Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 2

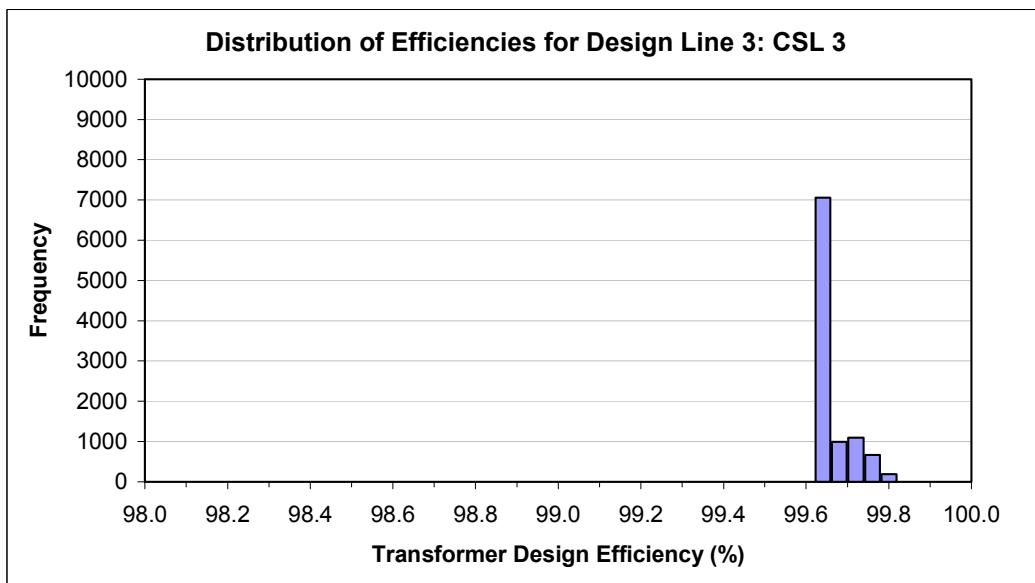


Figure 8E.4.16 Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 3

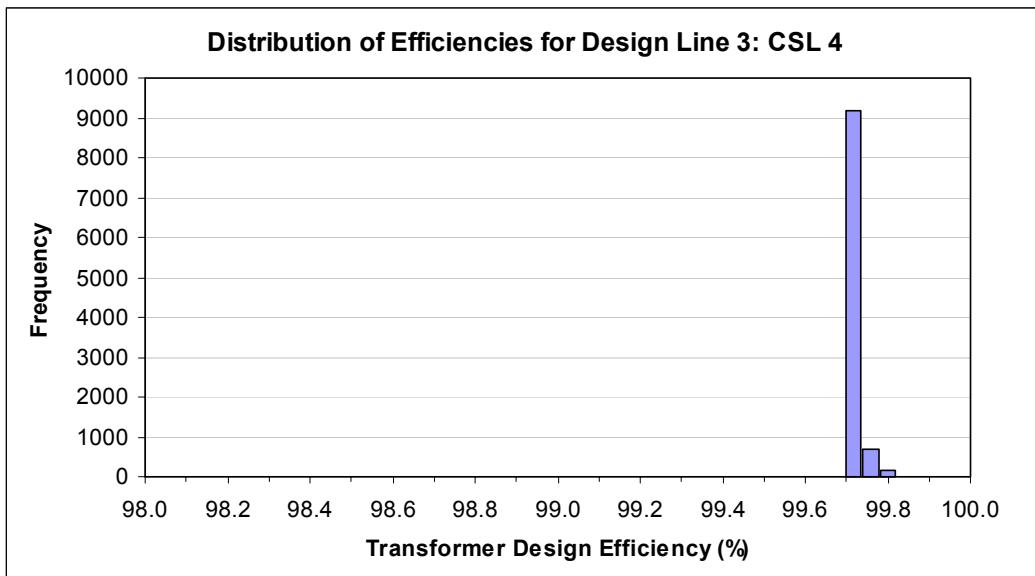


Figure 8E.4.17

Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 4

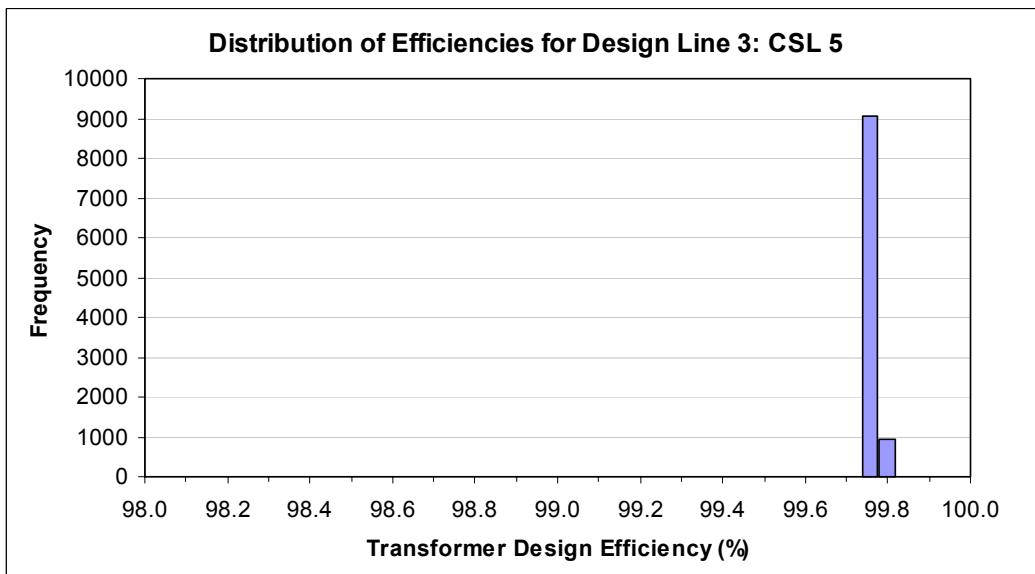


Figure 8E.4.18

Distribution of Efficiencies for Design Line 3 Representative Unit, CSL 5

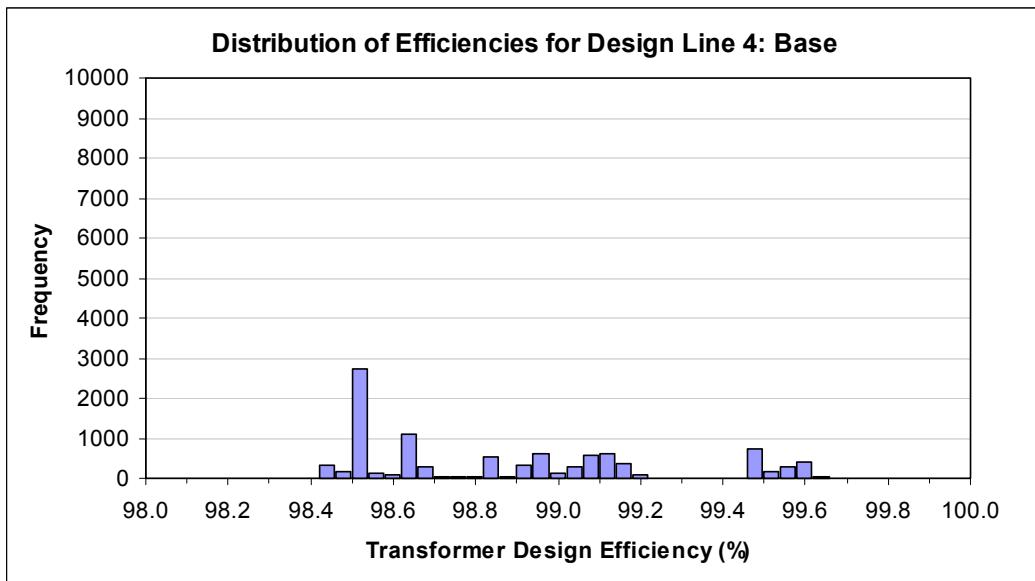


Figure 8E.4.19 Distribution of Efficiencies for Design Line 4 Representative Unit, Baseline

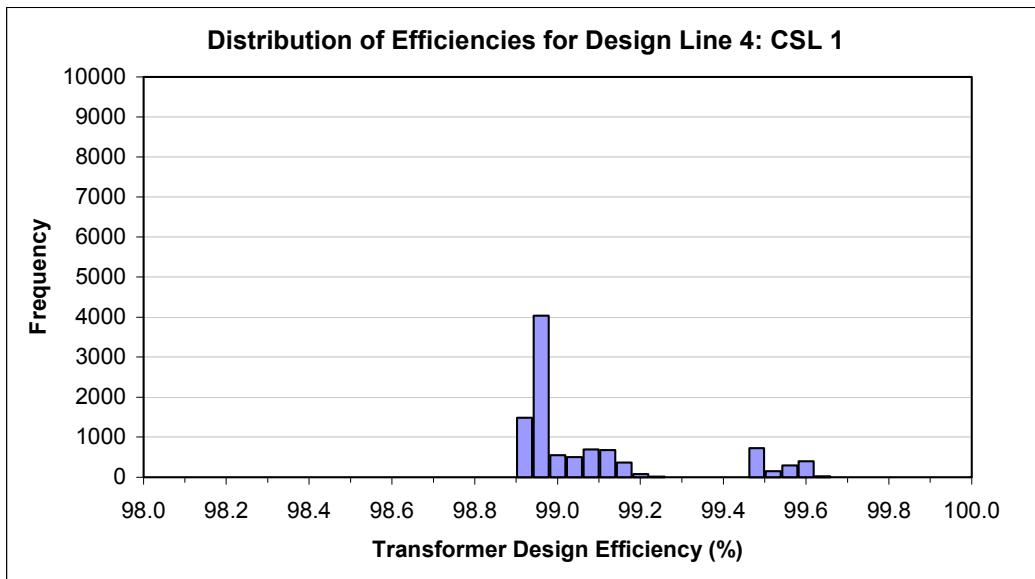


Figure 8E.4.20 Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 1

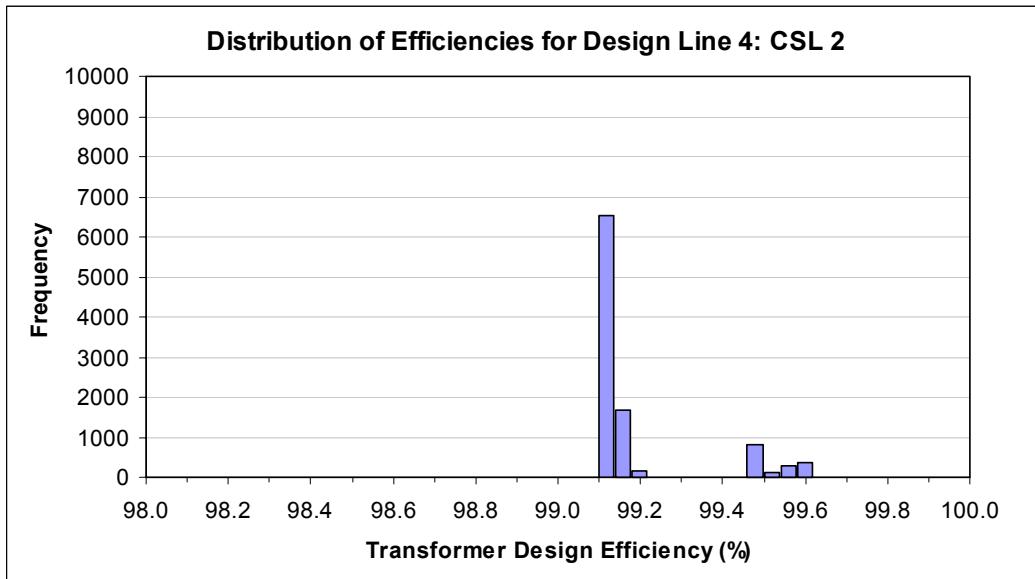


Figure 8E.4.21 Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 2

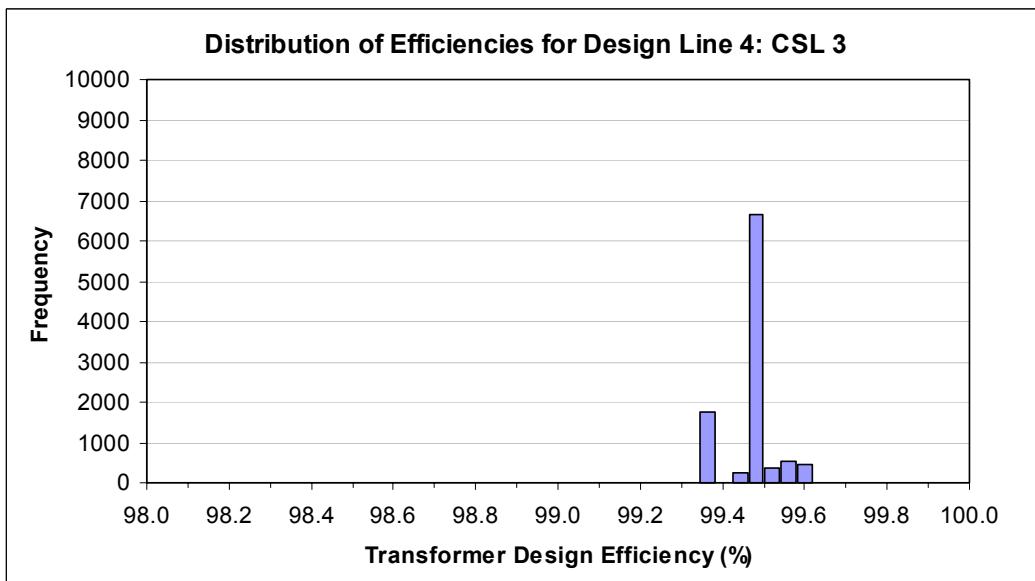


Figure 8E.4.22 Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 3

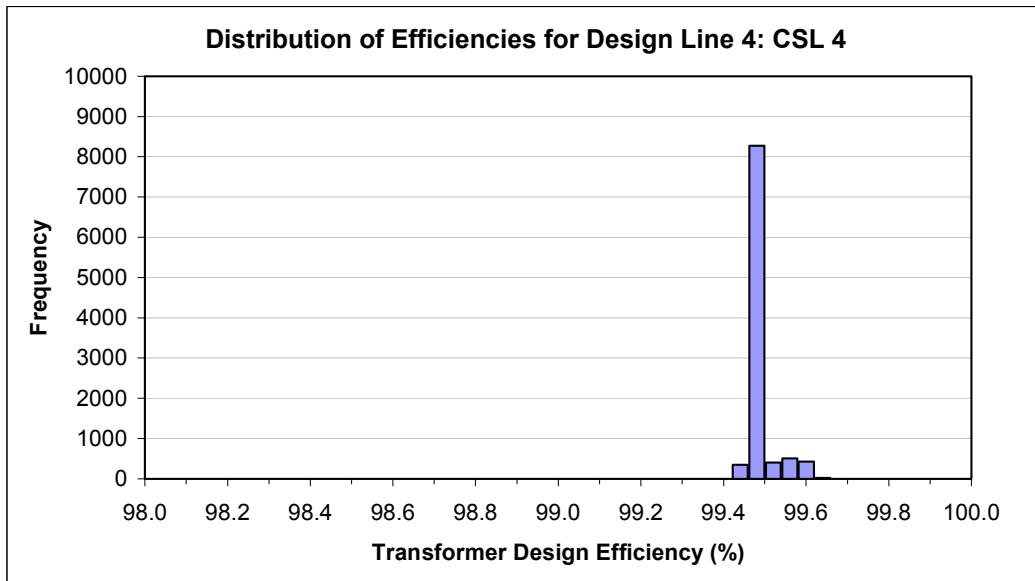


Figure 8E.4.23

Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 4

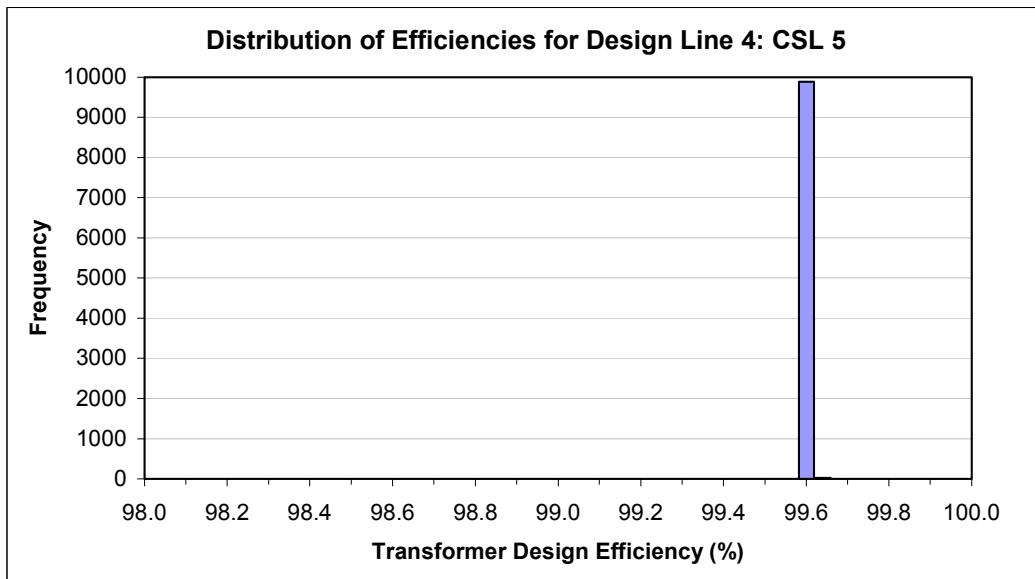


Figure 8E.4.24

Distribution of Efficiencies for Design Line 4 Representative Unit, CSL 5

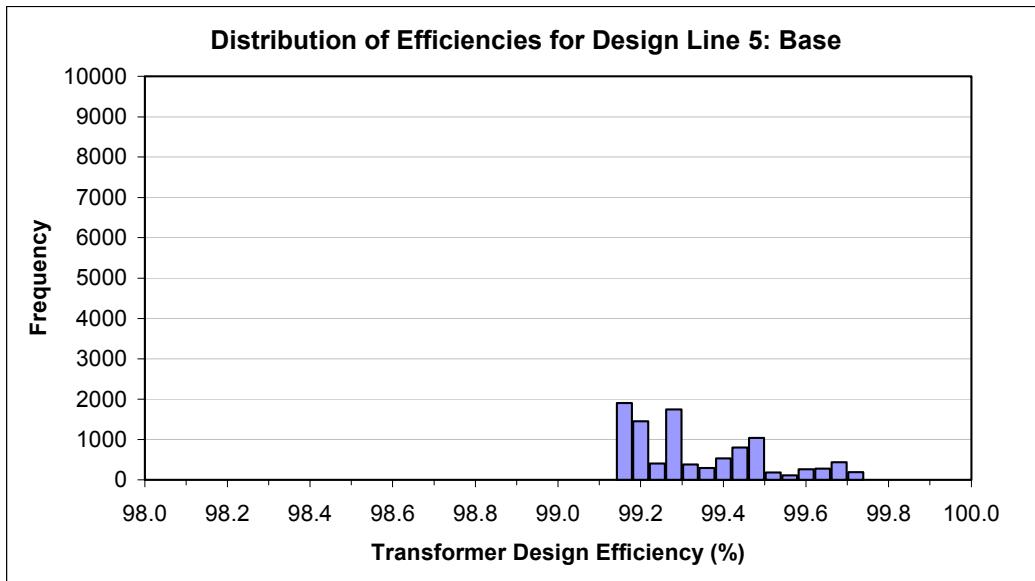


Figure 8E.4.25 Distribution of Efficiencies for Design Line 5 Representative Unit, Baseline

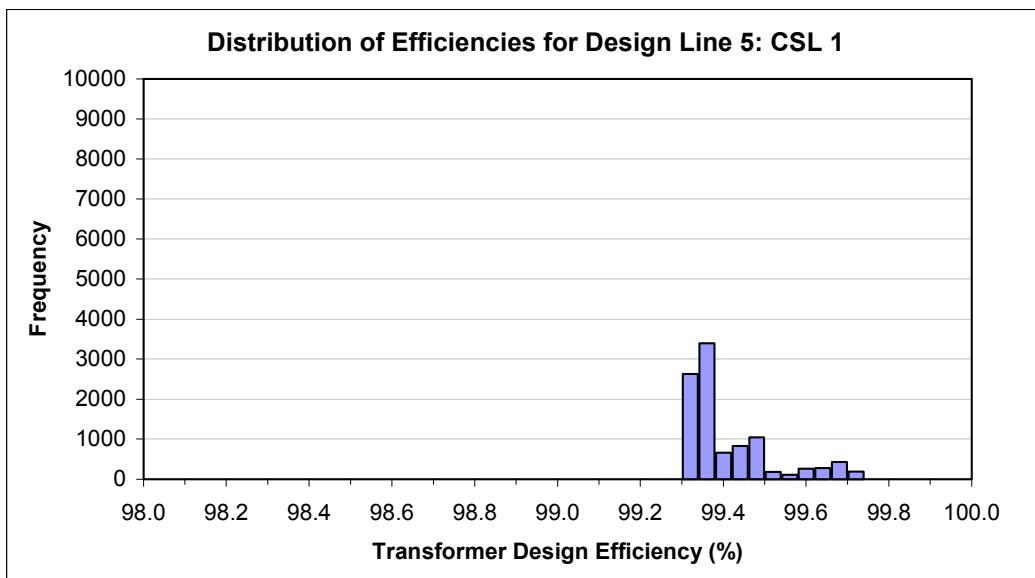


Figure 8E.4.26 Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 1

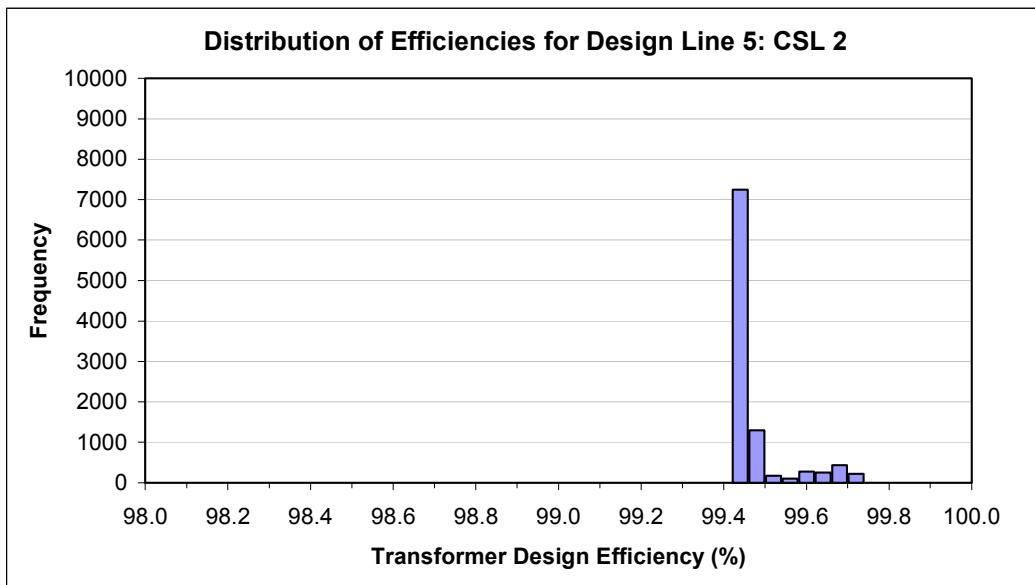


Figure 8E.4.27

Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 2

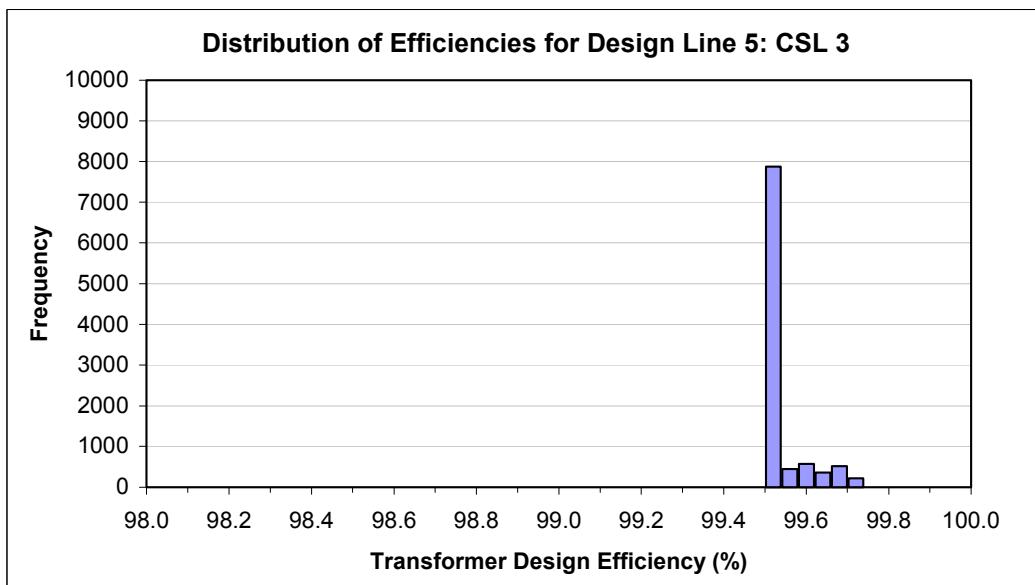


Figure 8E.4.28

Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 3

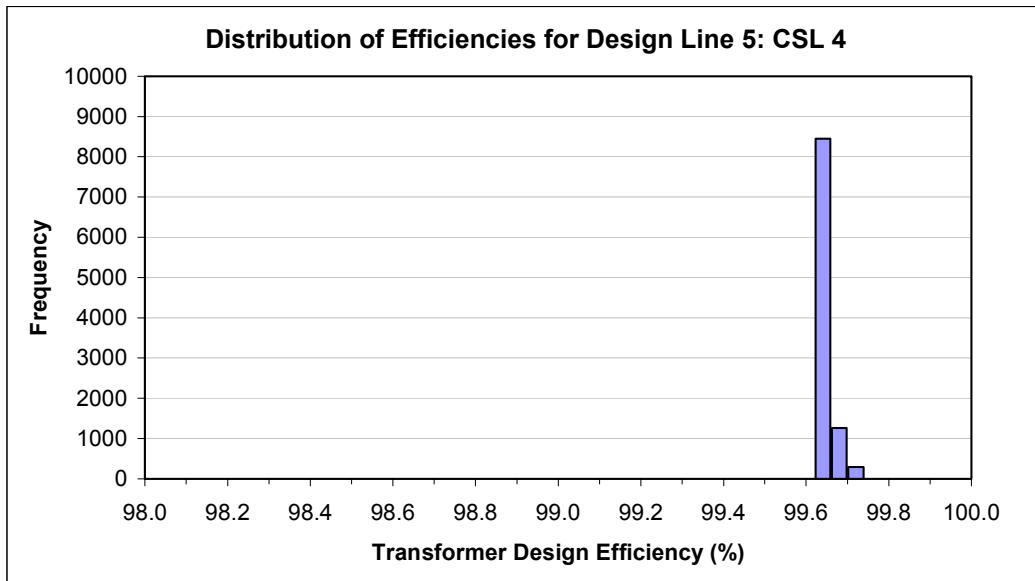


Figure 8E.4.29 Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 4

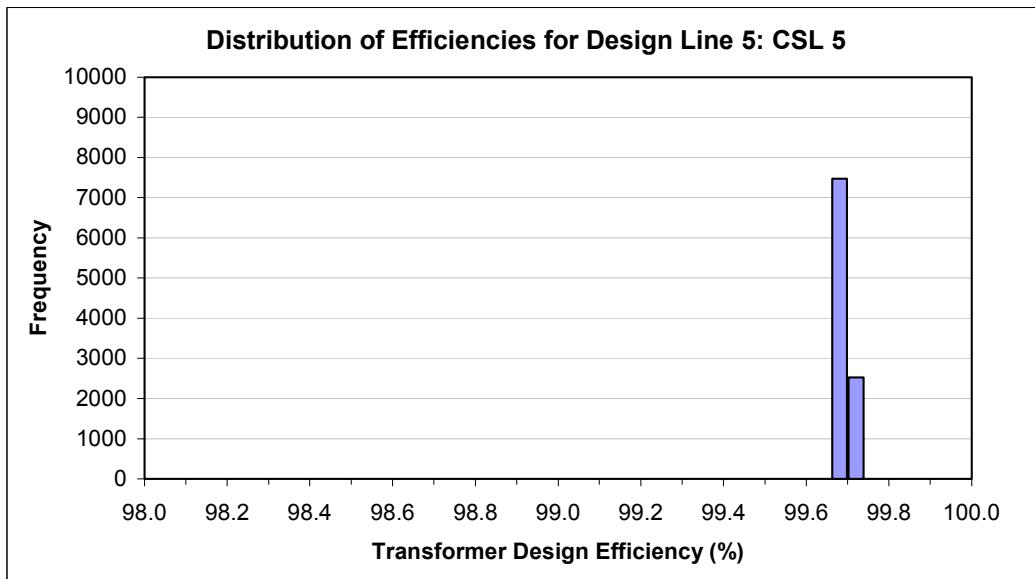


Figure 8E.4.30 Distribution of Efficiencies for Design Line 5 Representative Unit, CSL 5

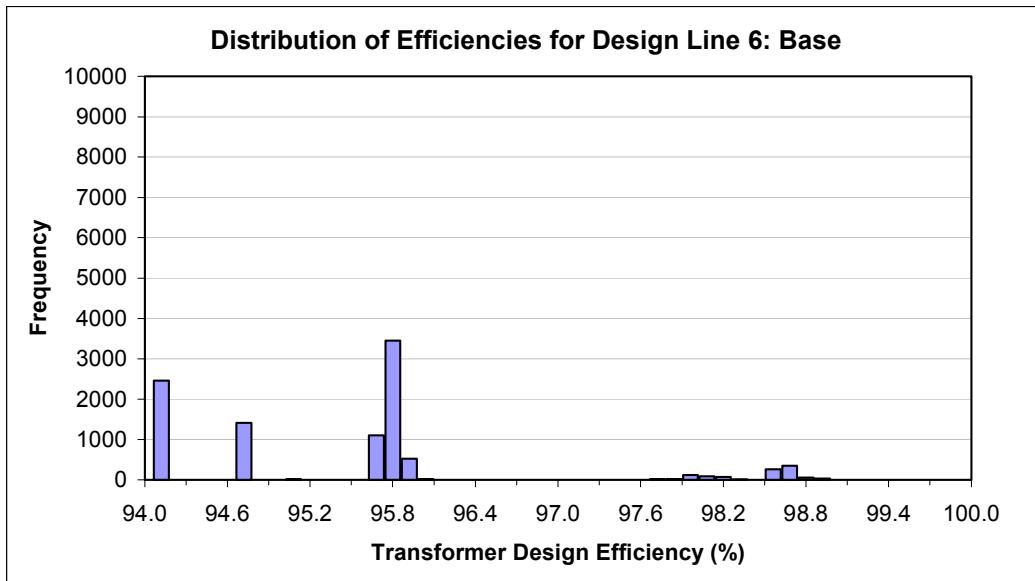


Figure 8E.4.31 Distribution of Efficiencies for Design Line 6 Representative Unit, Baseline

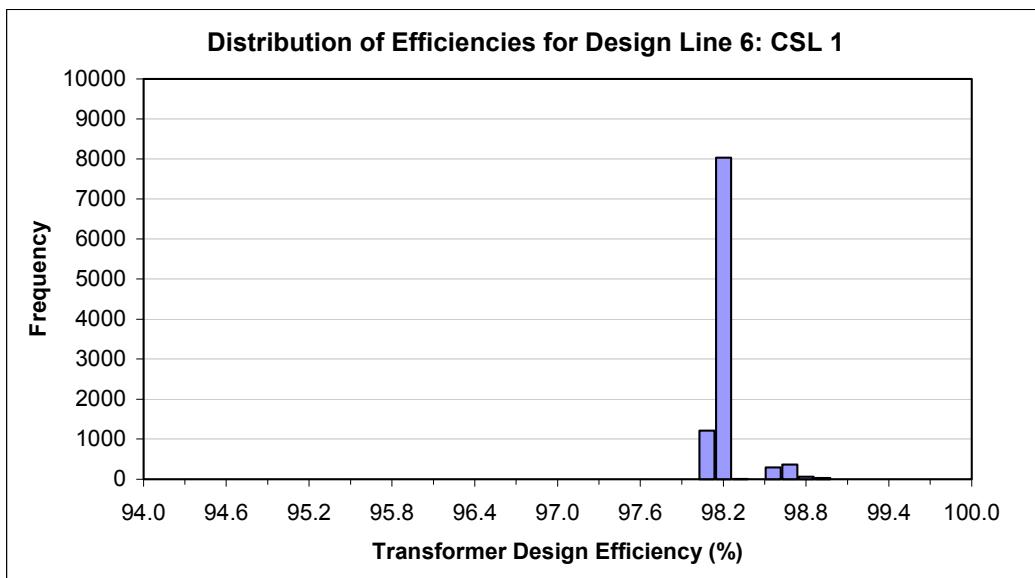


Figure 8E.4.32 Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 1

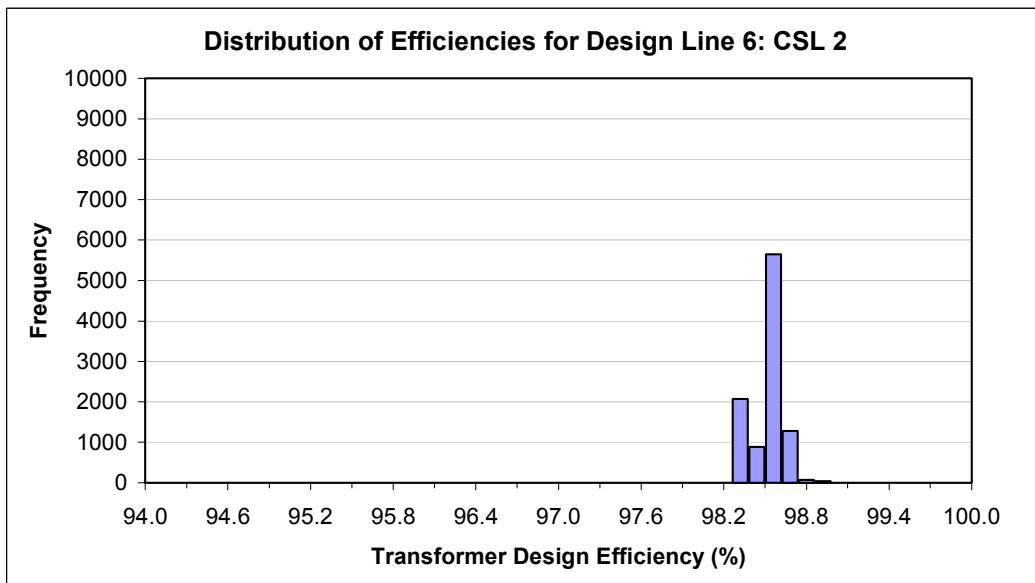


Figure 8E.4.33

Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 2

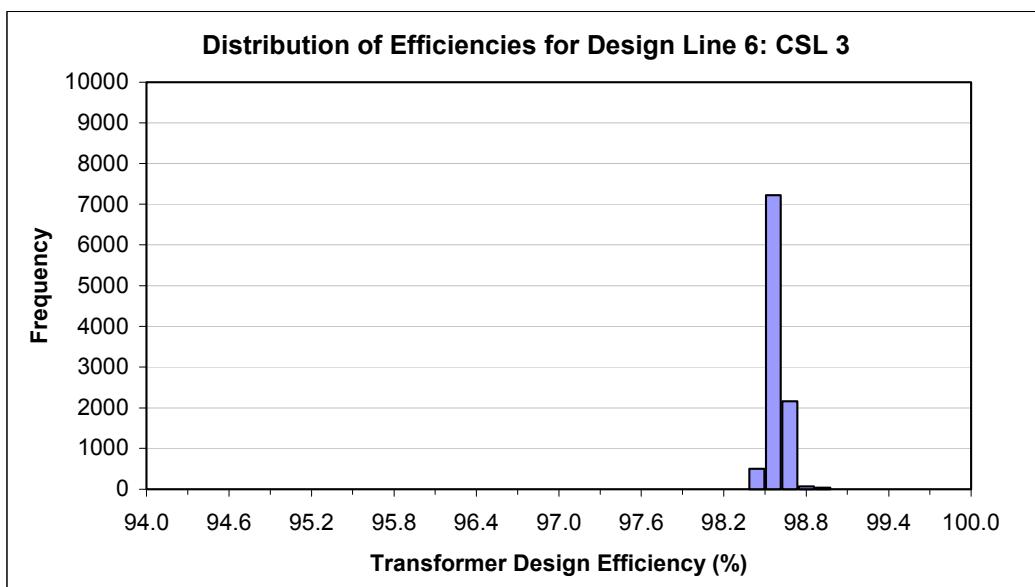


Figure 8E.4.34

Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 3

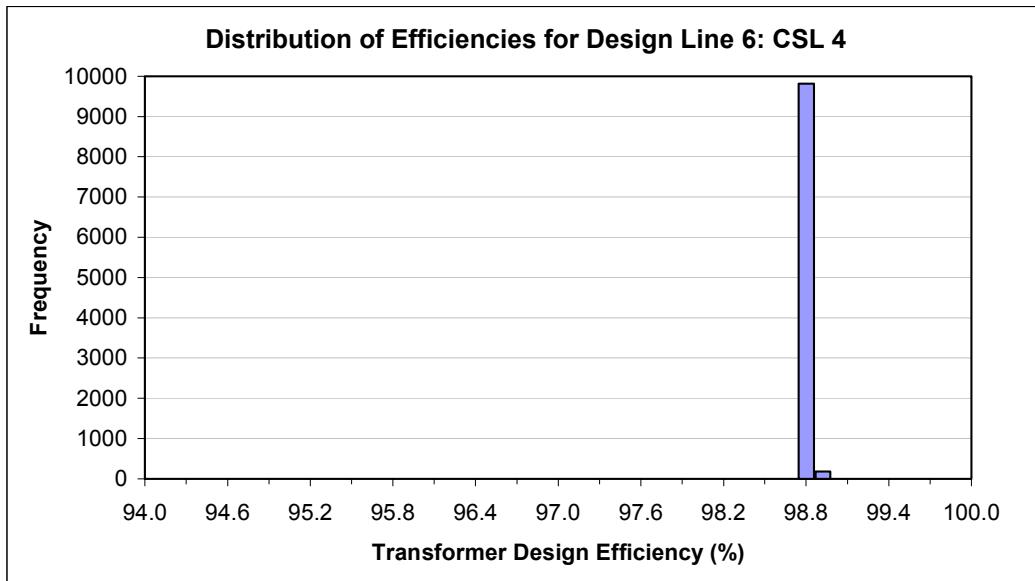


Figure 8E.4.35 Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 4

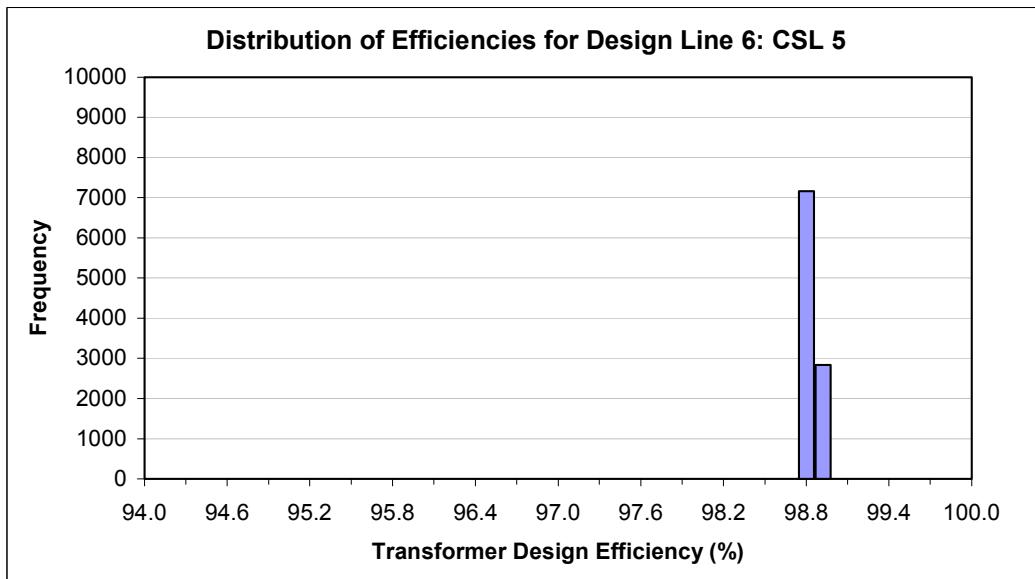


Figure 8E.4.36 Distribution of Efficiencies for Design Line 6 Representative Unit, CSL 5

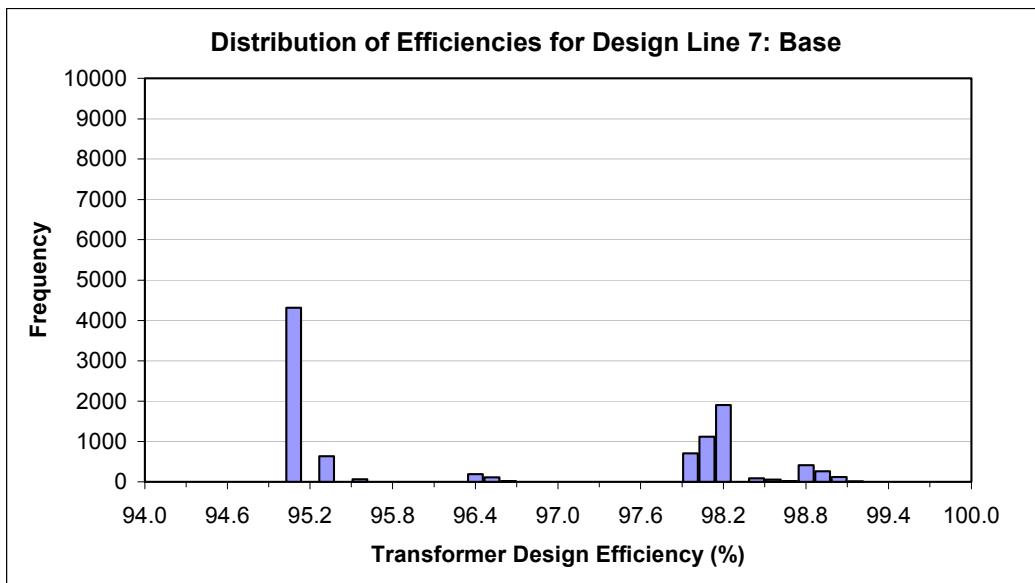


Figure 8E.4.37 Distribution of Efficiencies for Design Line 7 Representative Unit, Baseline

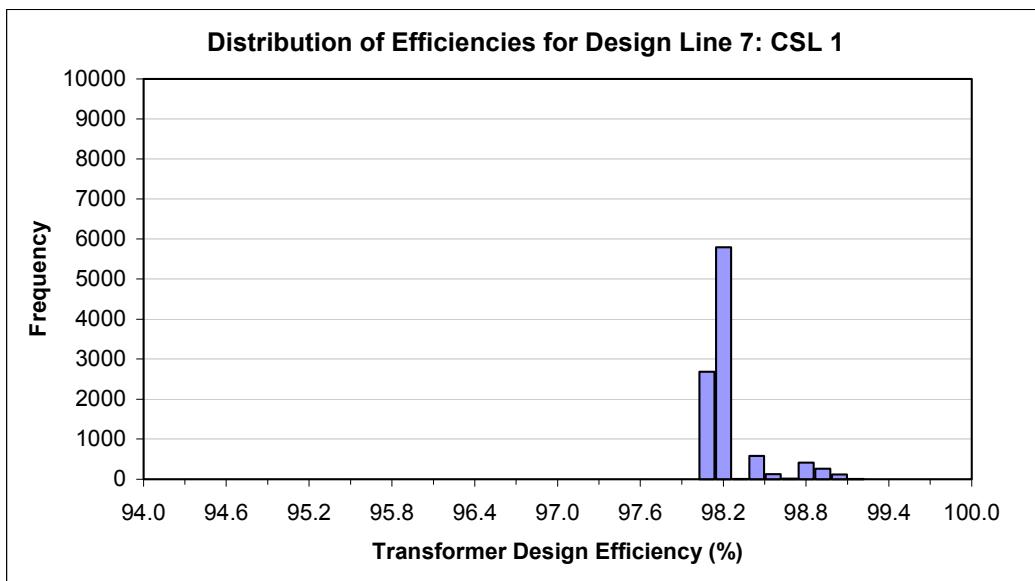


Figure 8E.4.38 Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 1

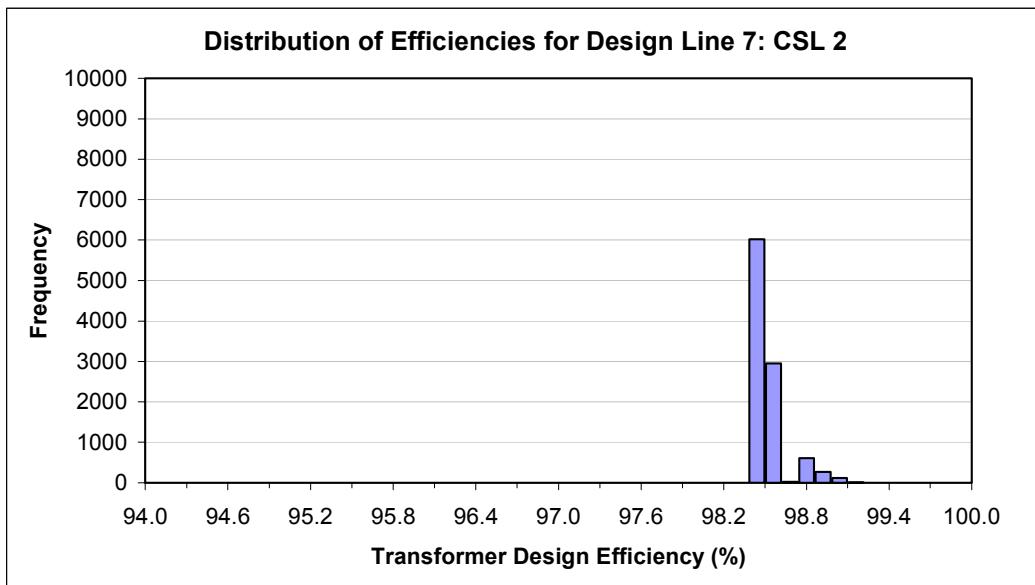


Figure 8E.4.39 Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 2

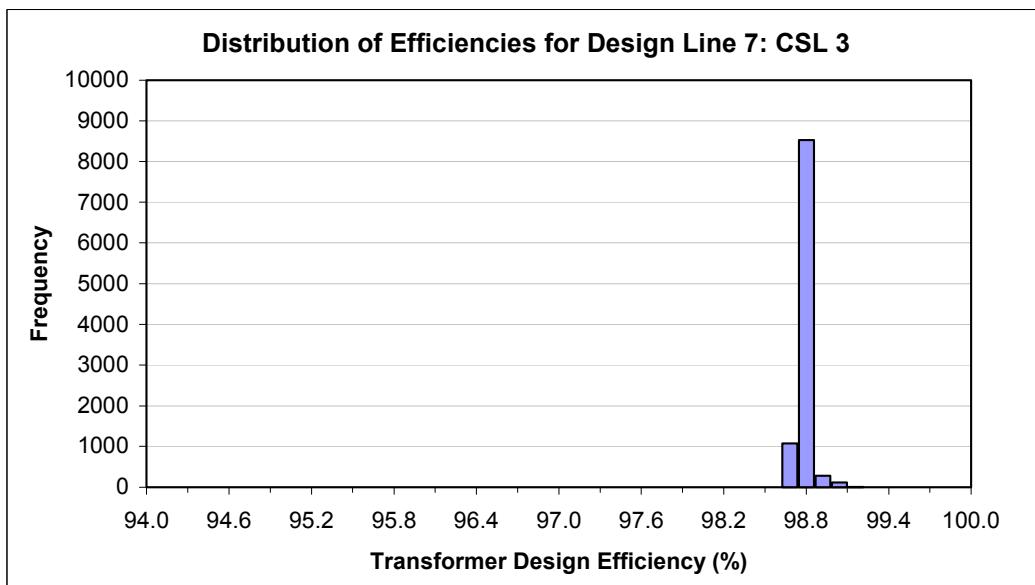


Figure 8E.4.40 Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 3

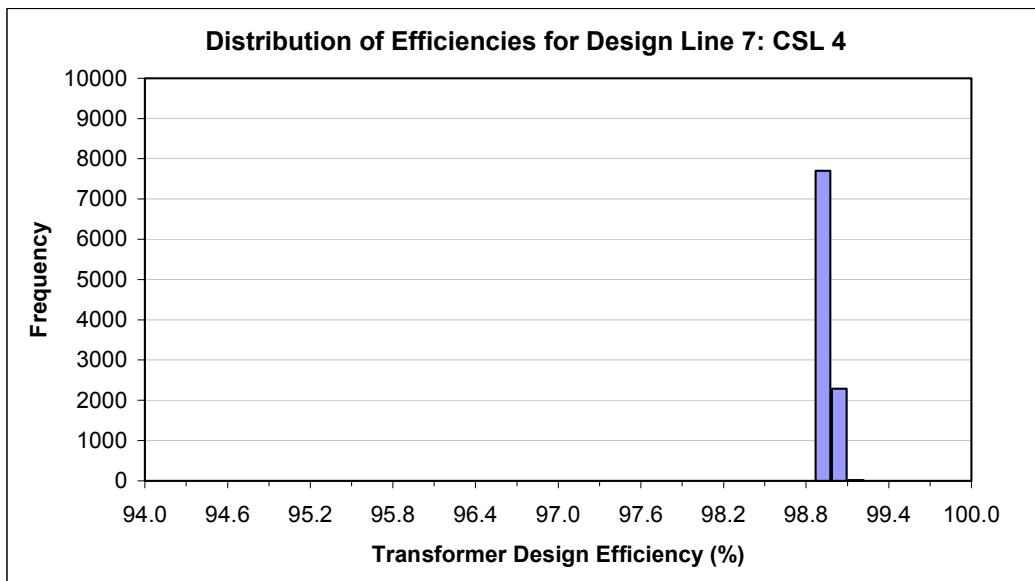


Figure 8E.4.41 Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 4

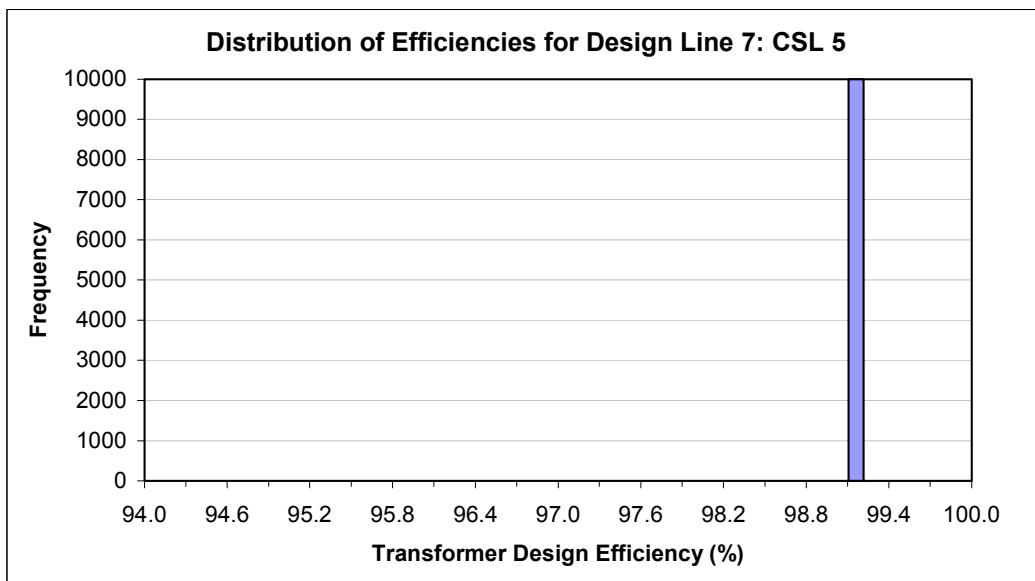


Figure 8E.4.42 Distribution of Efficiencies for Design Line 7 Representative Unit, CSL 5

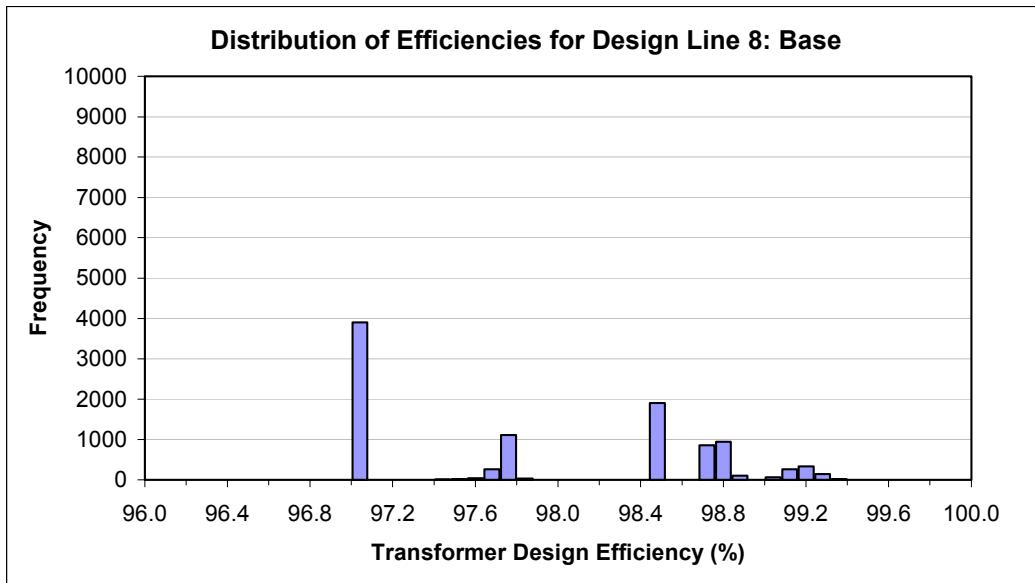


Figure 8E.4.43 Distribution of Efficiencies for Design Line 8 Representative Unit, Baseline

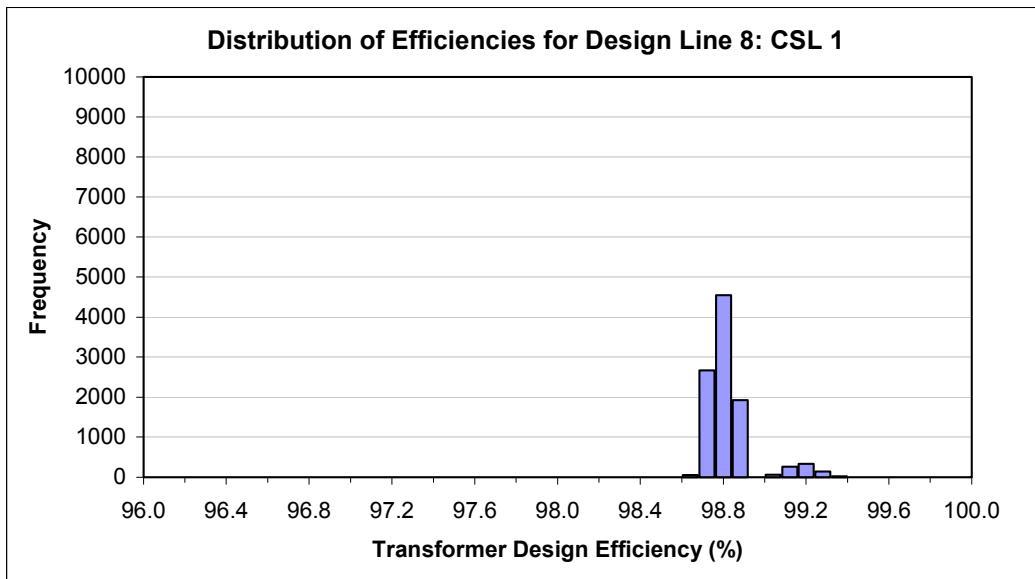


Figure 8E.4.44 Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 1

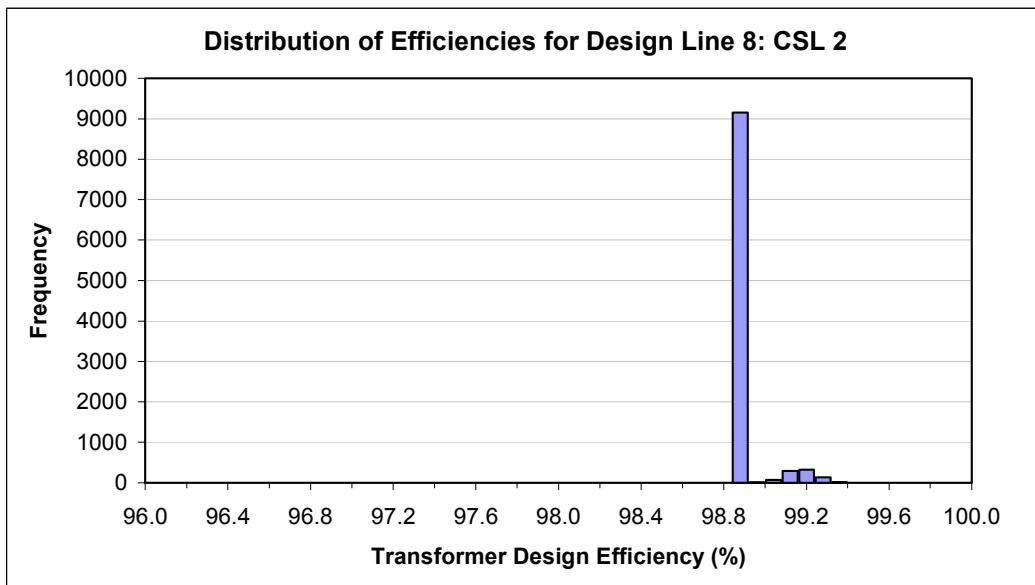


Figure 8E.4.45 Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 2

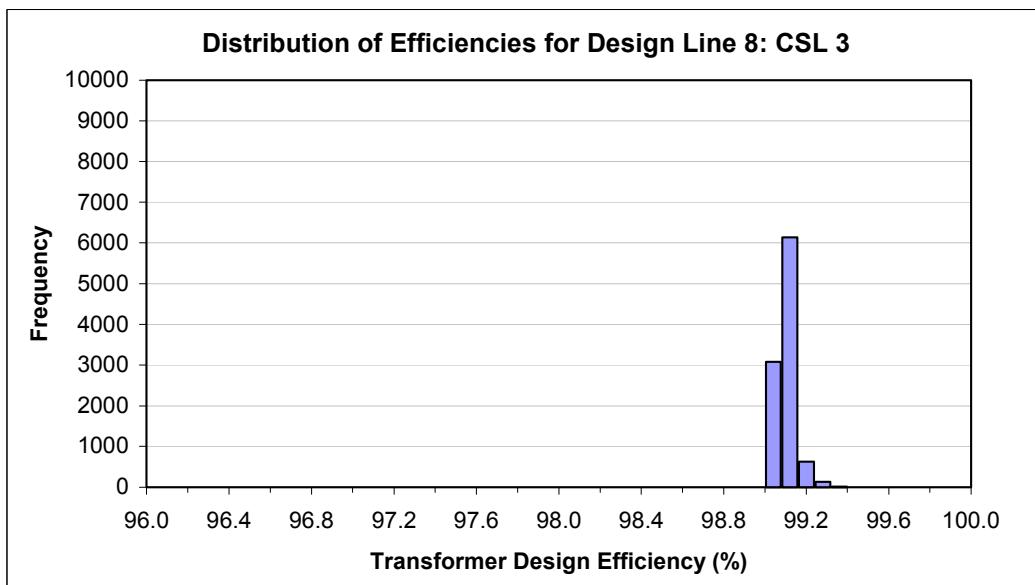


Figure 8E.4.46 Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 3

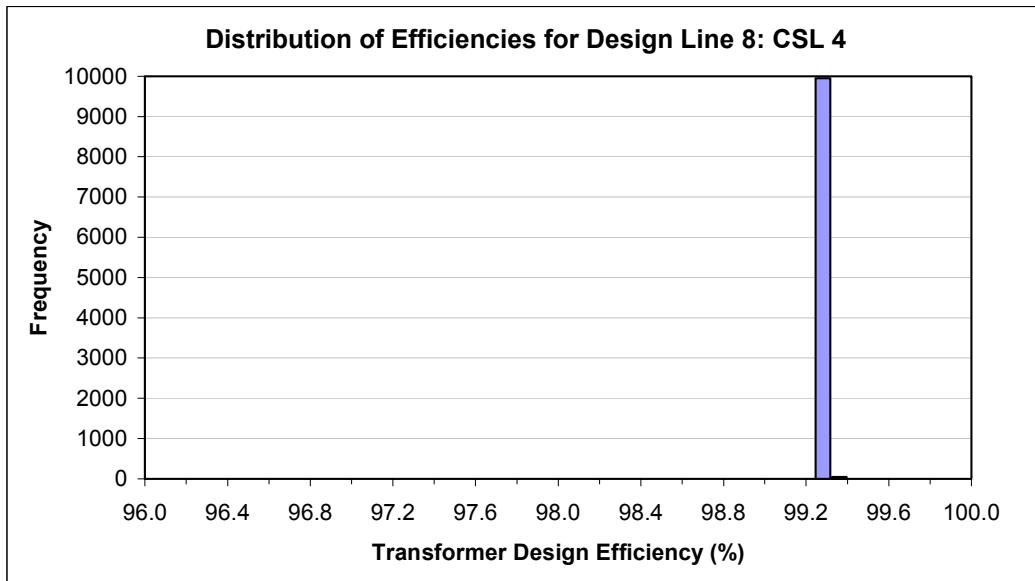


Figure 8E.4.47

Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 4

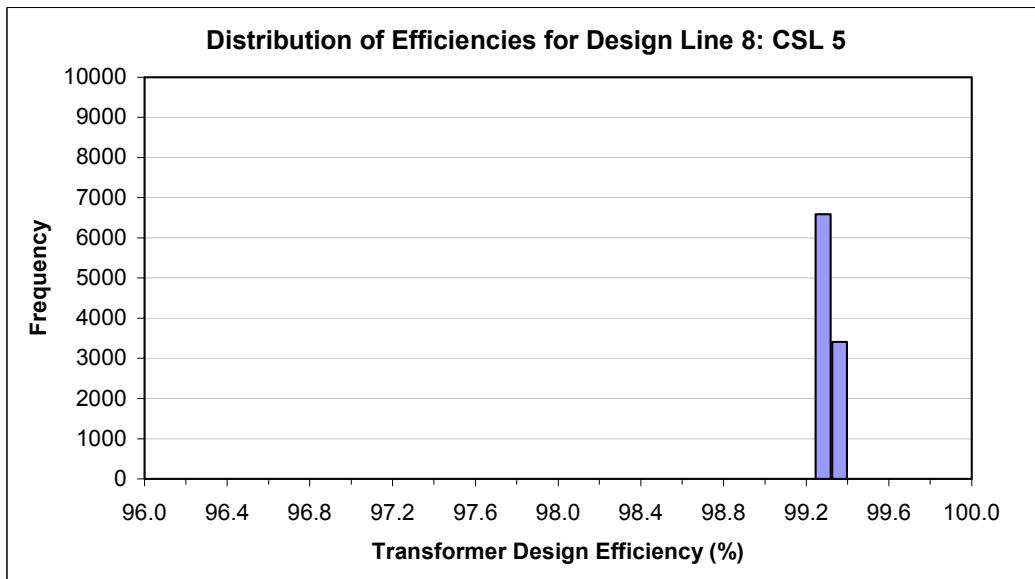


Figure 8E.4.48

Distribution of Efficiencies for Design Line 8 Representative Unit, CSL 5

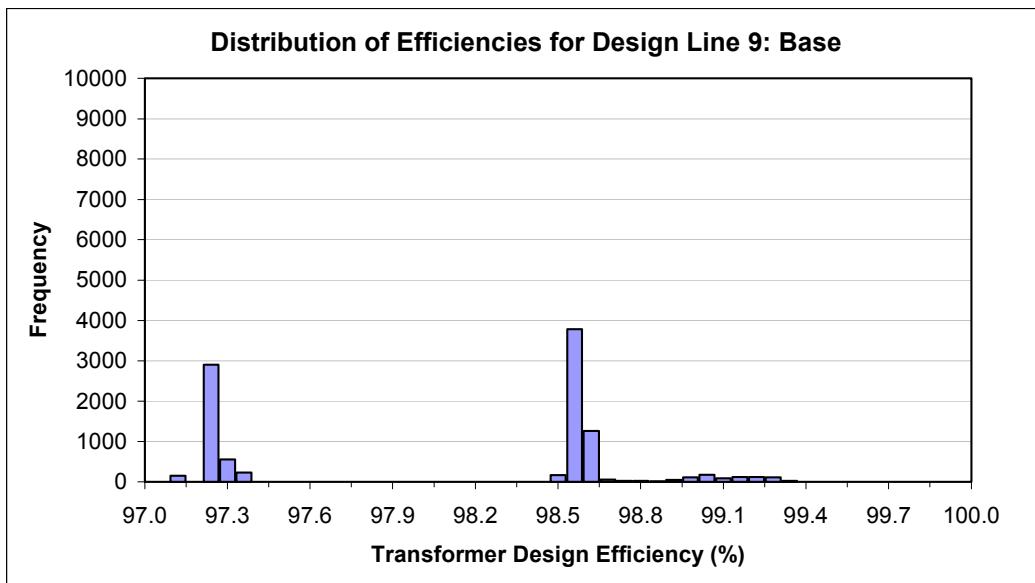


Figure 8E.4.49 Distribution of Efficiencies for Design Line 9 Representative Unit, Baseline

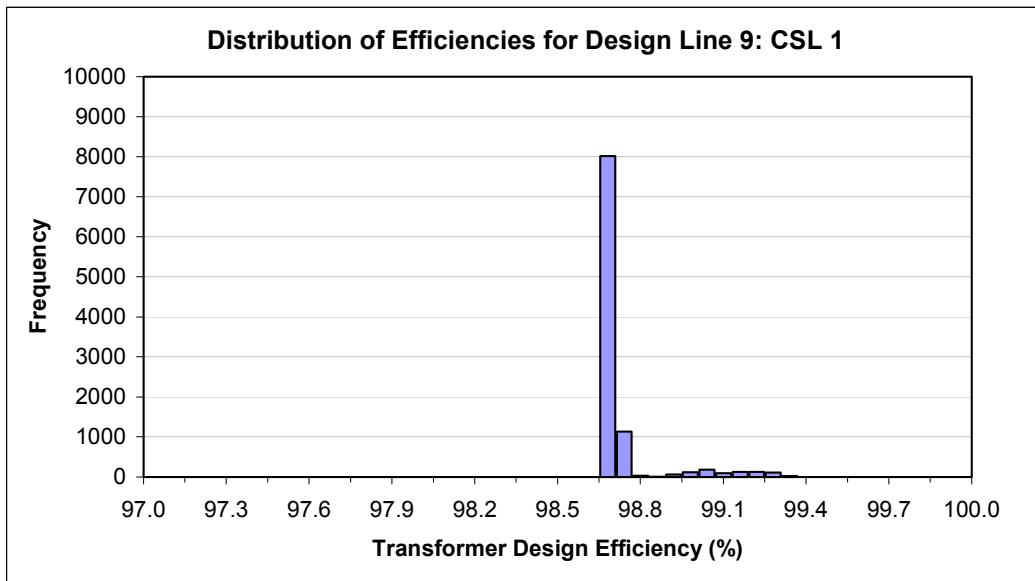


Figure 8E.4.50 Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 1

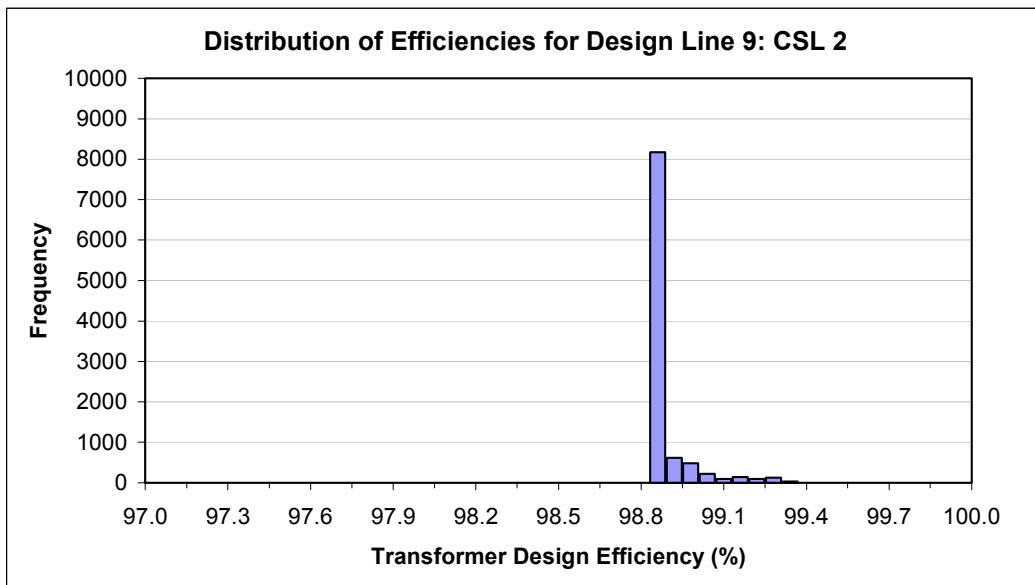


Figure 8E.4.51 Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 2

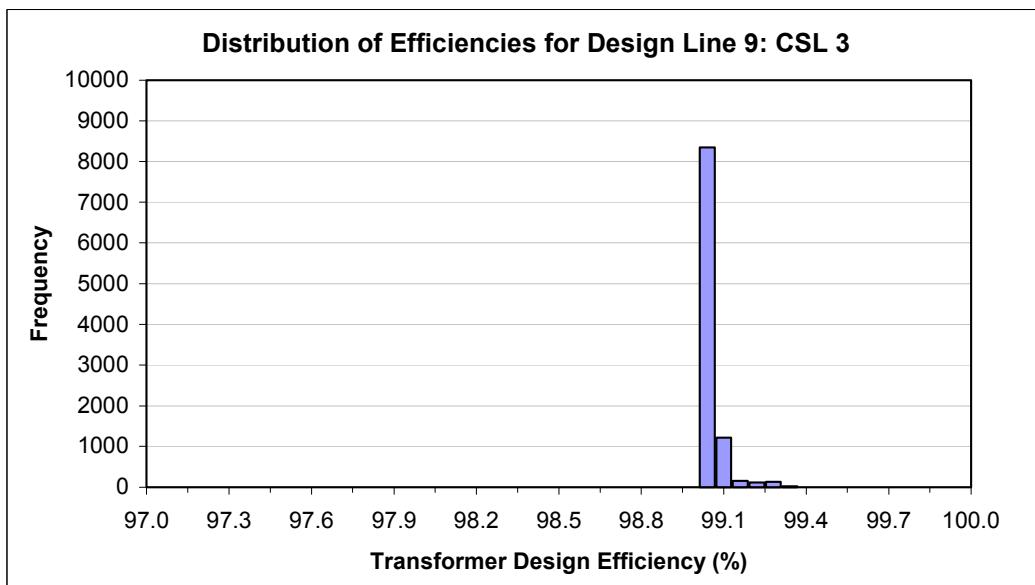


Figure 8E.4.52 Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 3

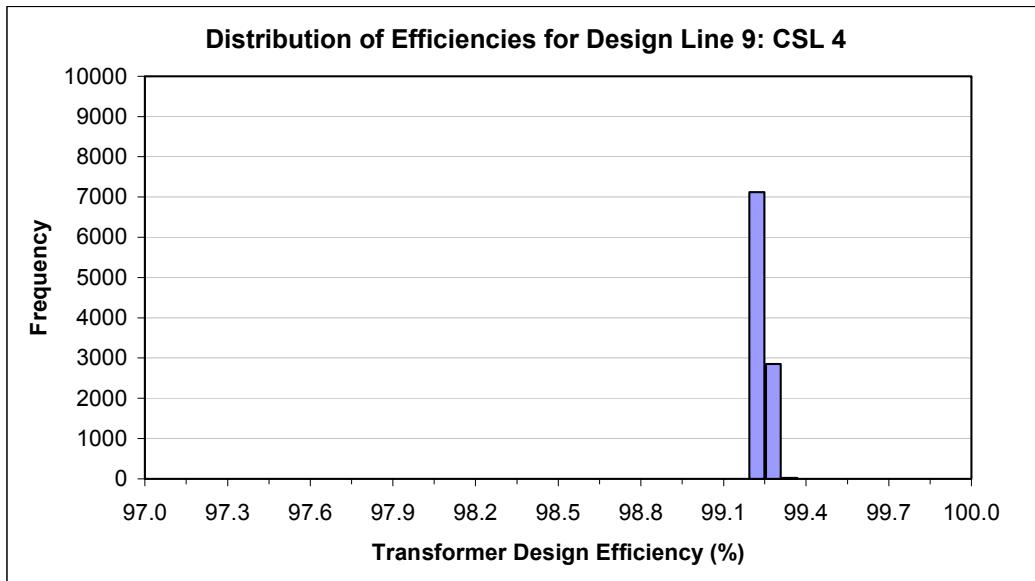


Figure 8E.4.53

Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 4

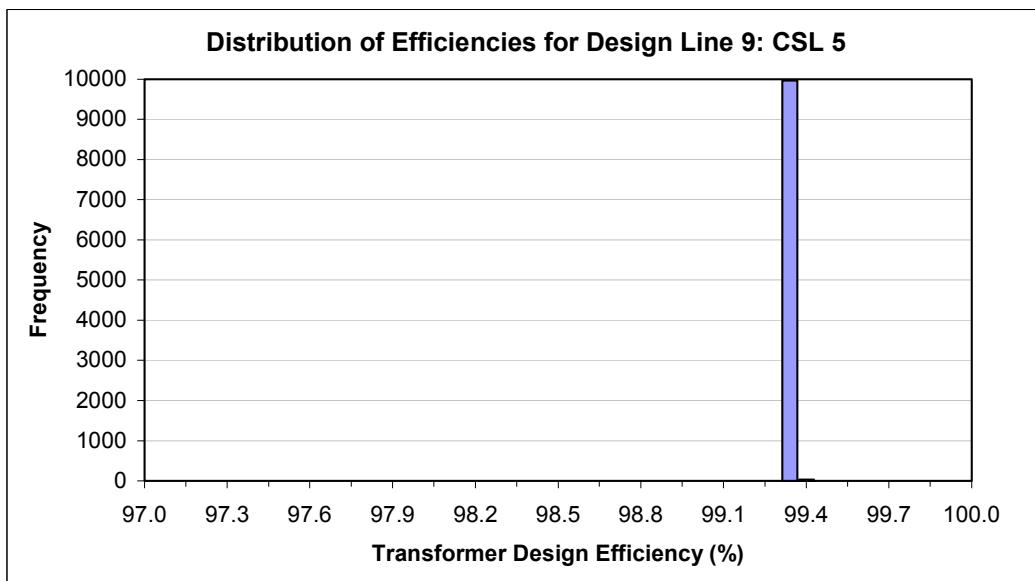


Figure 8E.4.54

Distribution of Efficiencies for Design Line 9 Representative Unit, CSL 5

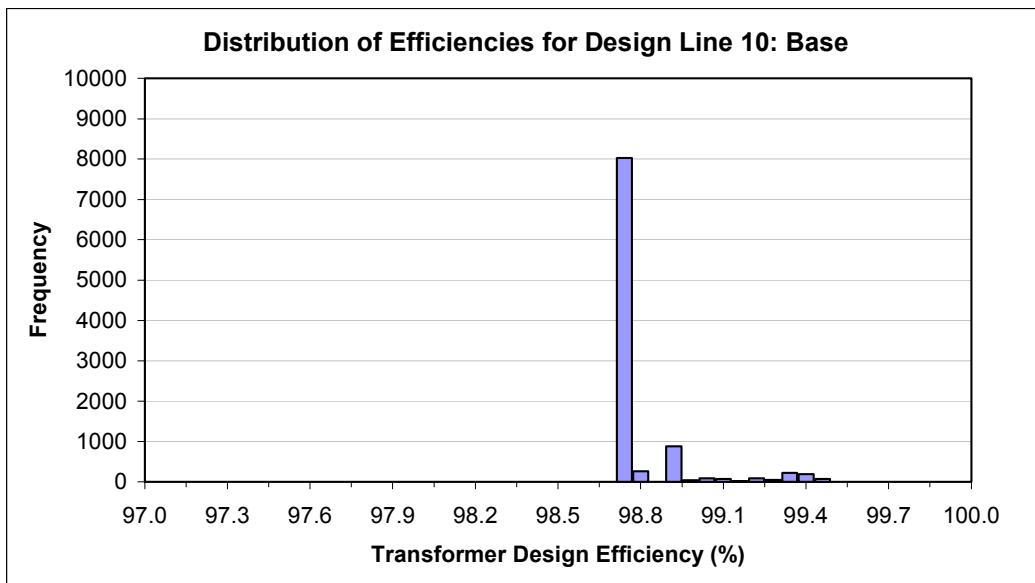


Figure 8E.4.55

Distribution of Efficiencies for Design Line 10 Representative Unit, Baseline

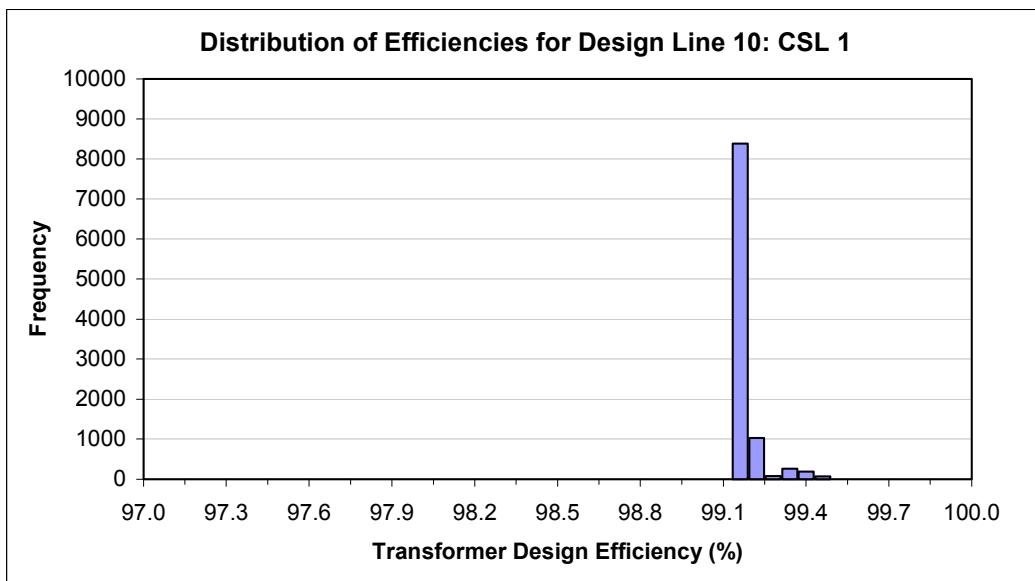


Figure 8E.4.56

Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 1

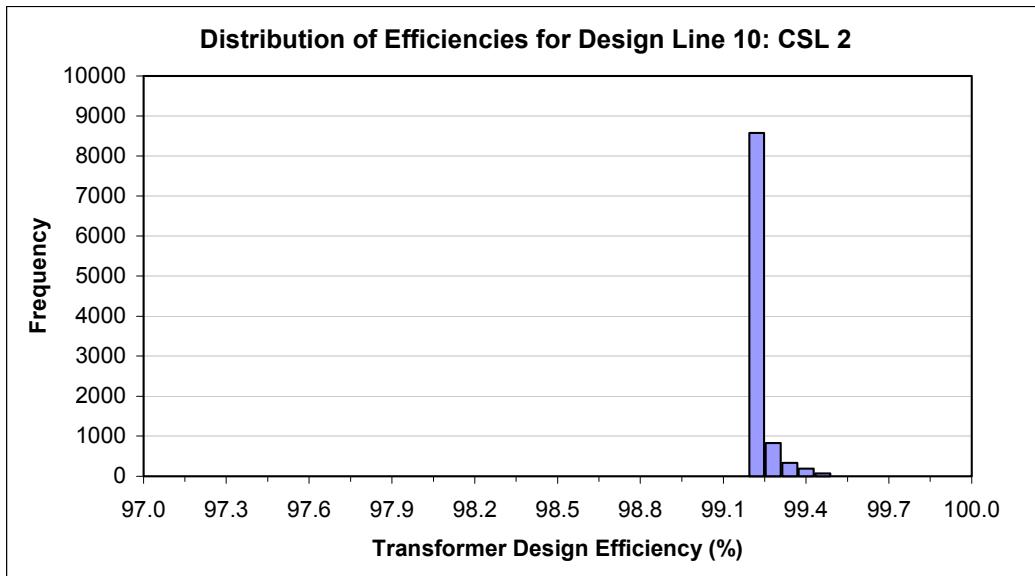


Figure 8E.4.57 Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 2

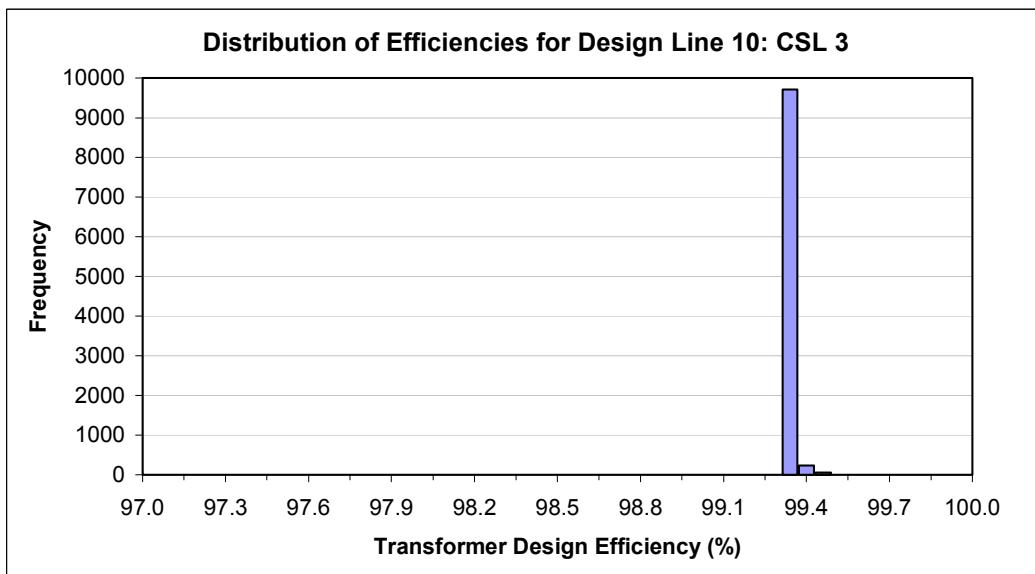


Figure 8E.4.58 Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 3

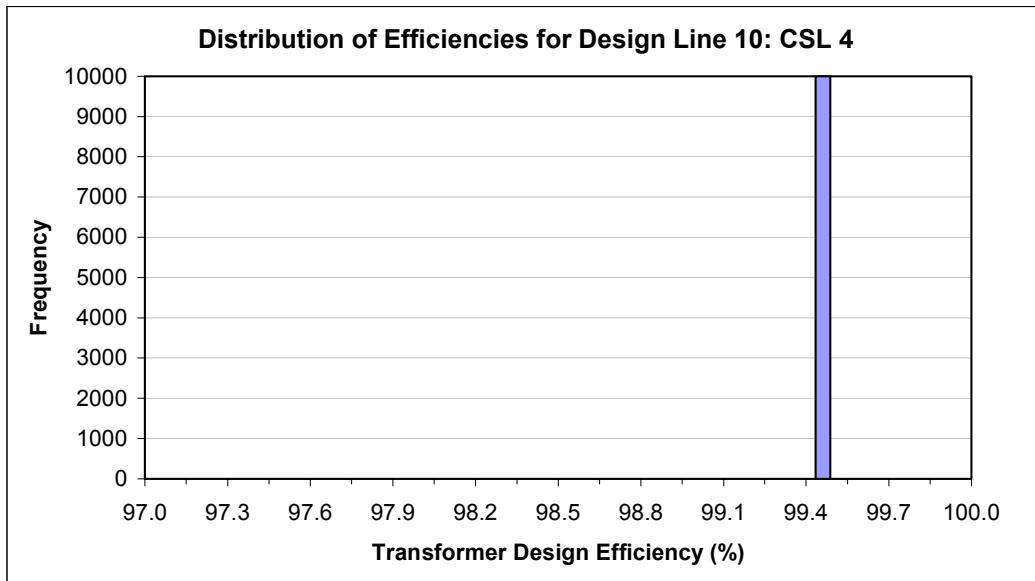


Figure 8E.4.59 Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 4

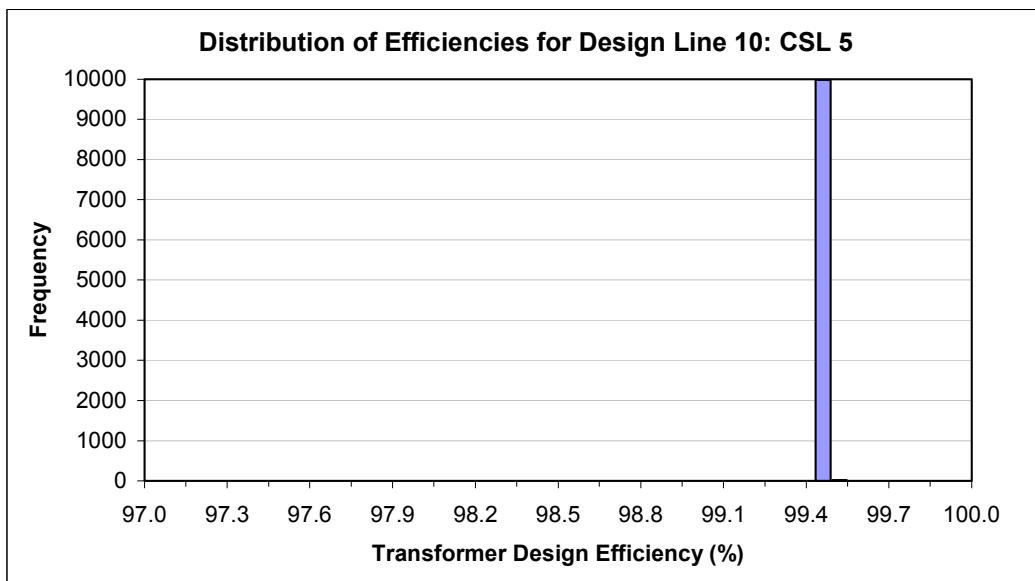


Figure 8E.4.60 Distribution of Efficiencies for Design Line 10 Representative Unit, CSL 5

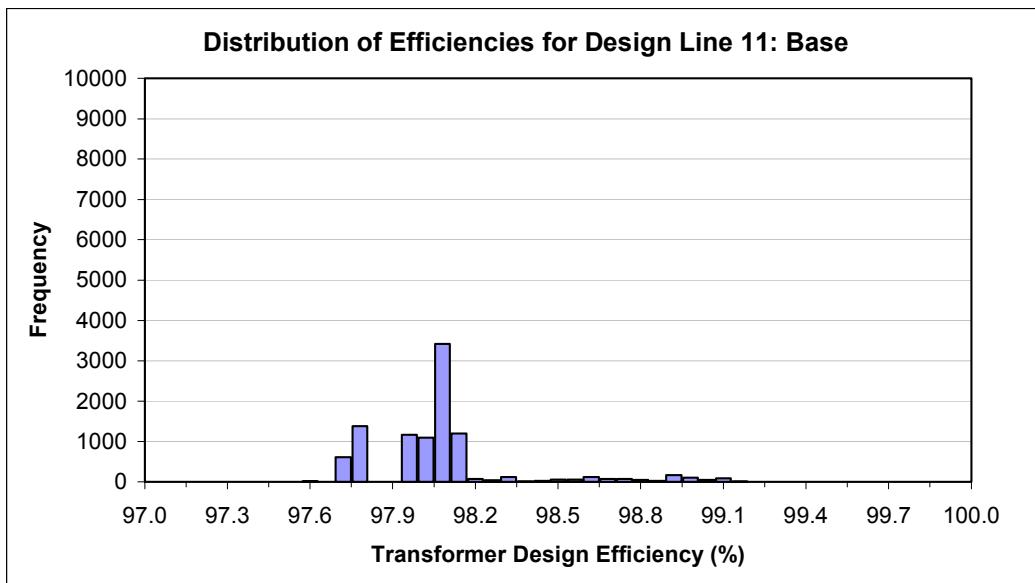


Figure 8E.4.61 Distribution of Efficiencies for Design Line 11 Representative Unit, Baseline

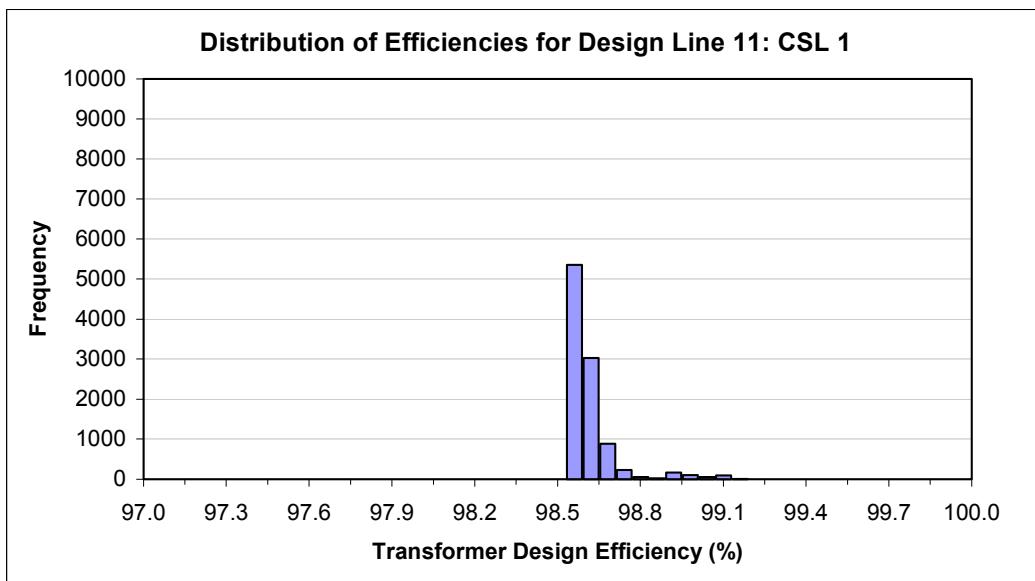


Figure 8E.4.62 Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 1

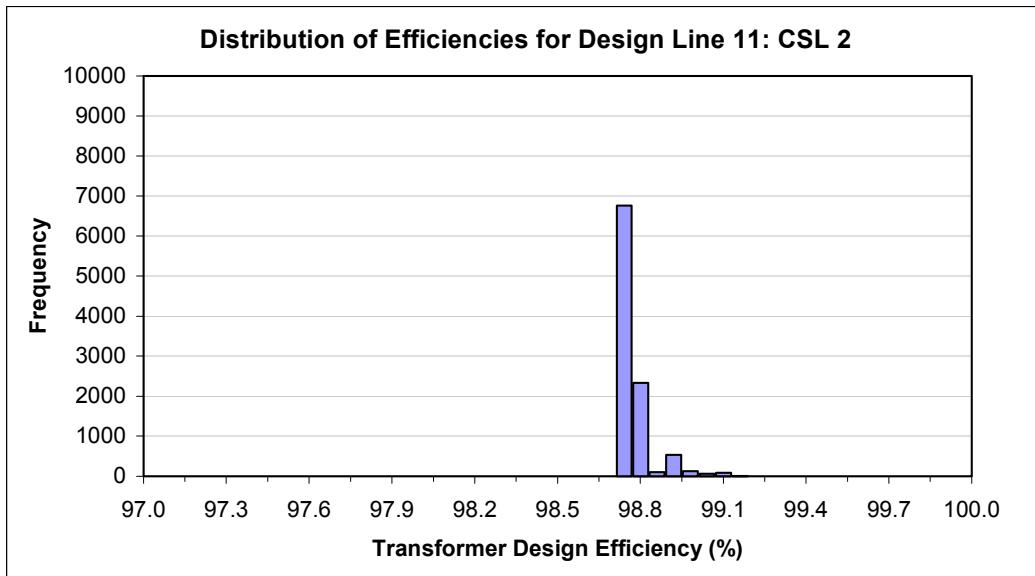


Figure 8E.4.63

Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 2

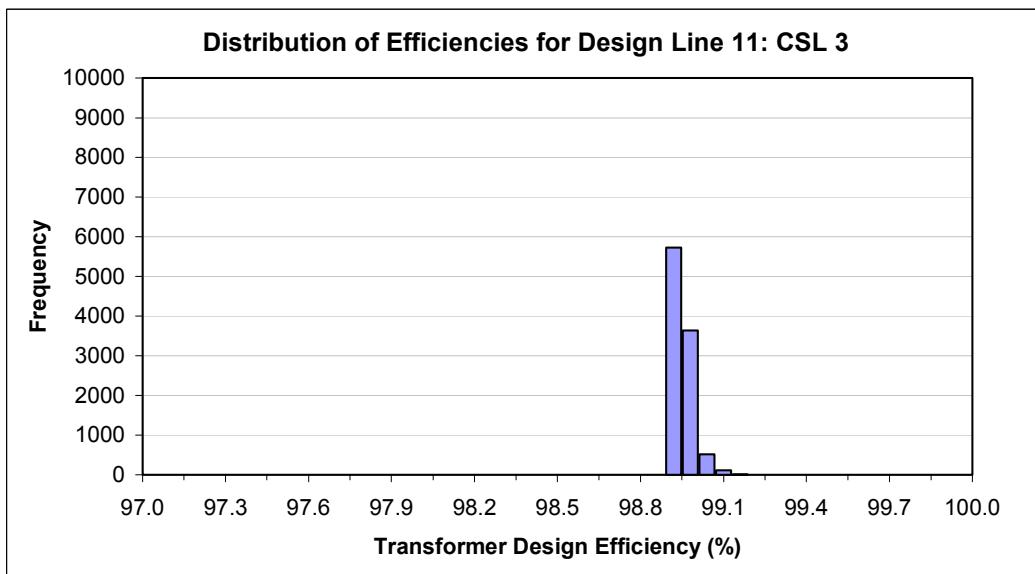


Figure 8E.4.64

Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 3

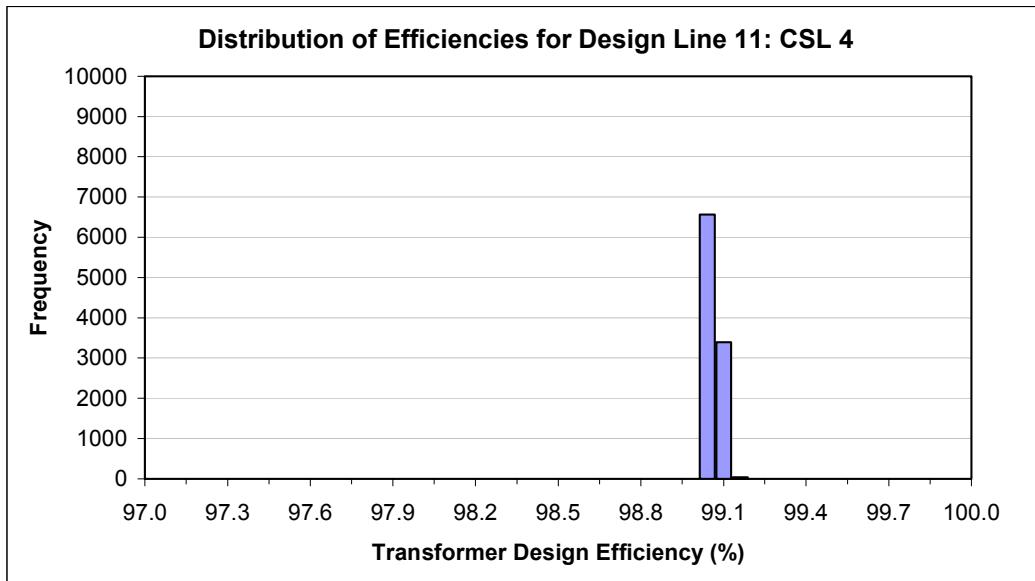


Figure 8E.4.65

Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 4

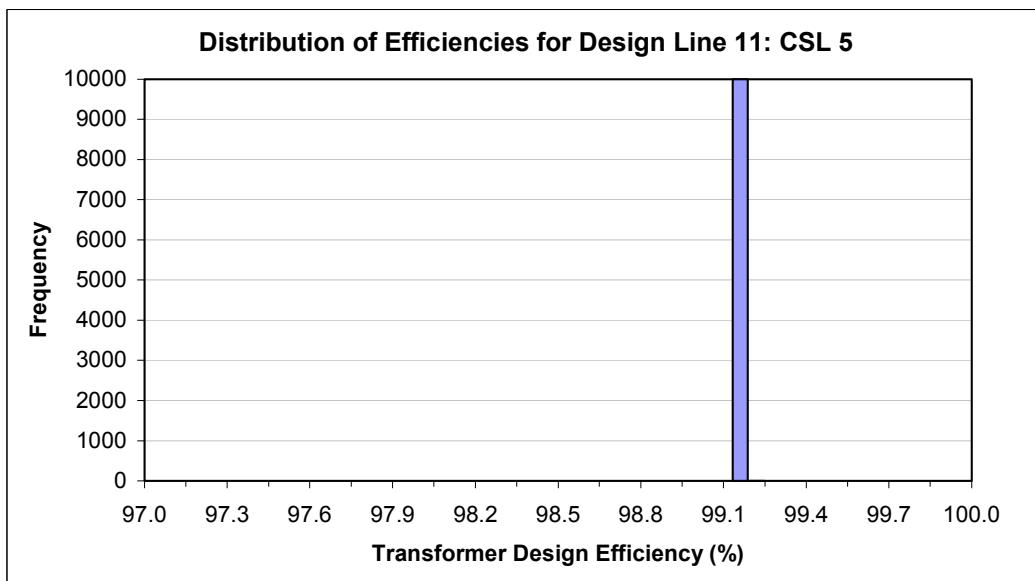


Figure 8E.4.66

Distribution of Efficiencies for Design Line 11 Representative Unit, CSL 5

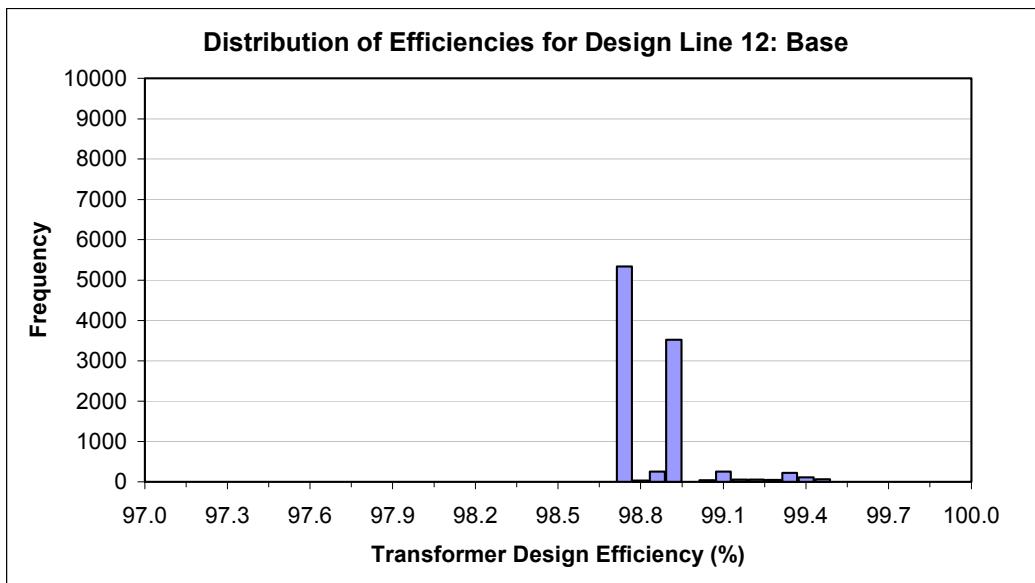


Figure 8E.4.67 Distribution of Efficiencies for Design Line 12 Representative Unit, Baseline

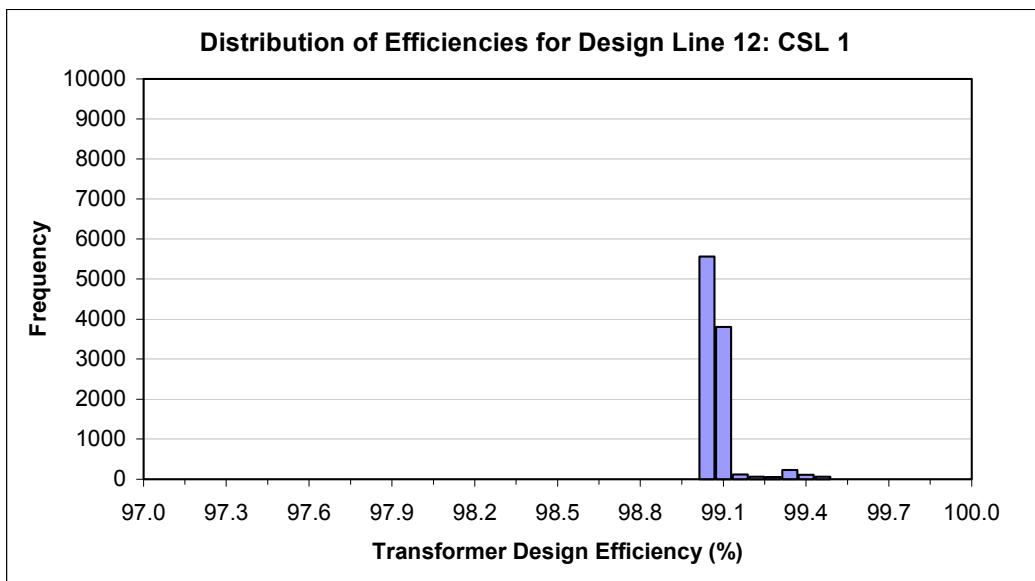


Figure 8E.4.68 Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 1

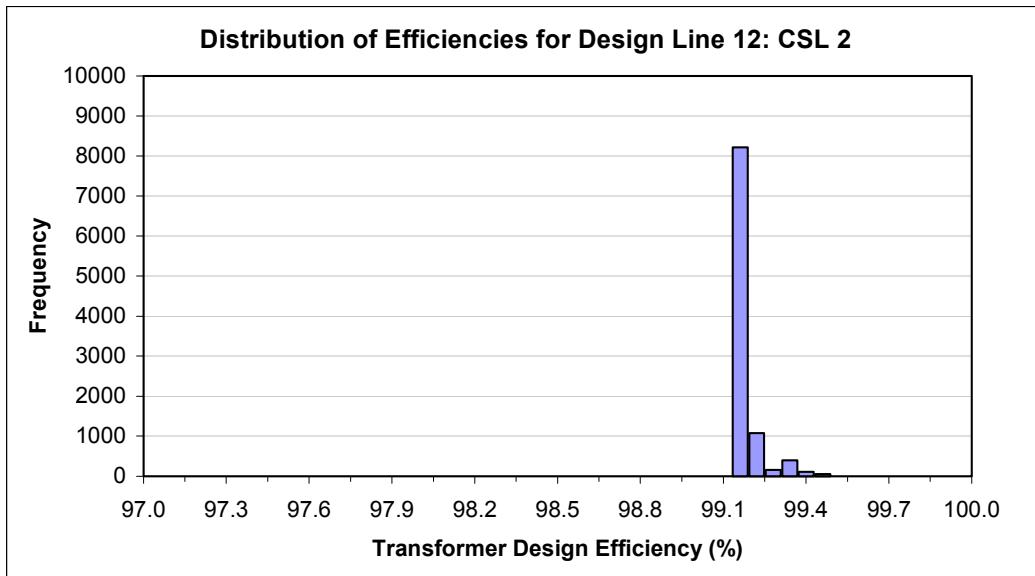


Figure 8E.4.69

Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 2

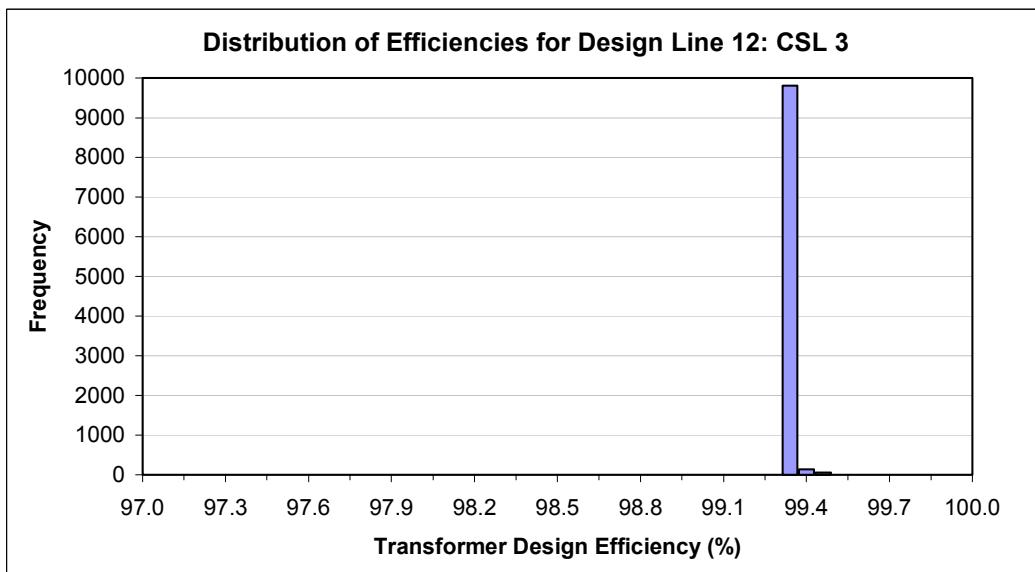


Figure 8E.4.70

Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 3

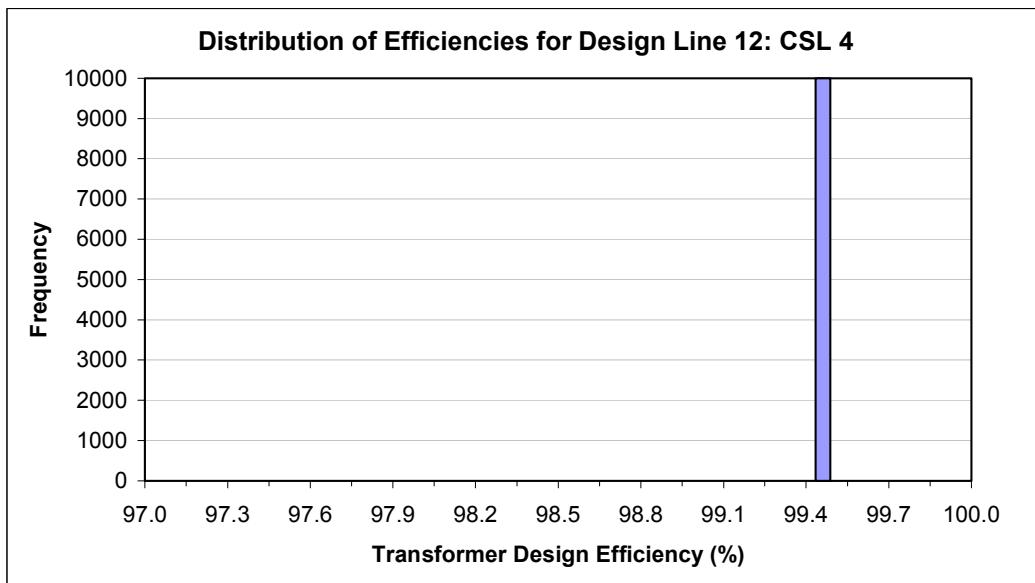


Figure 8E.4.71 Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 4

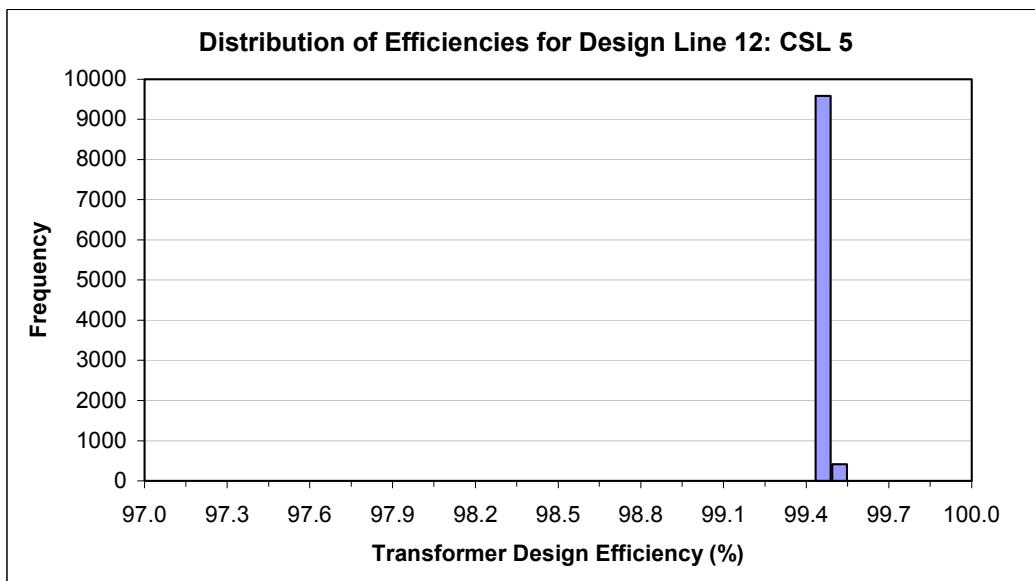


Figure 8E.4.72 Distribution of Efficiencies for Design Line 12 Representative Unit, CSL 5

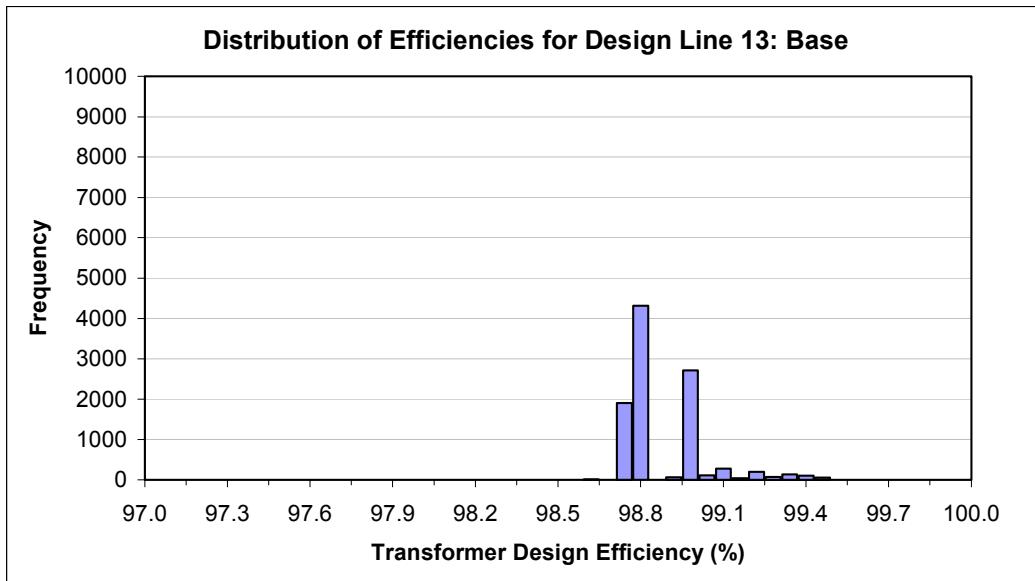


Figure 8E.4.73

Distribution of Efficiencies for Design Line 12 Representative Unit, Baseline

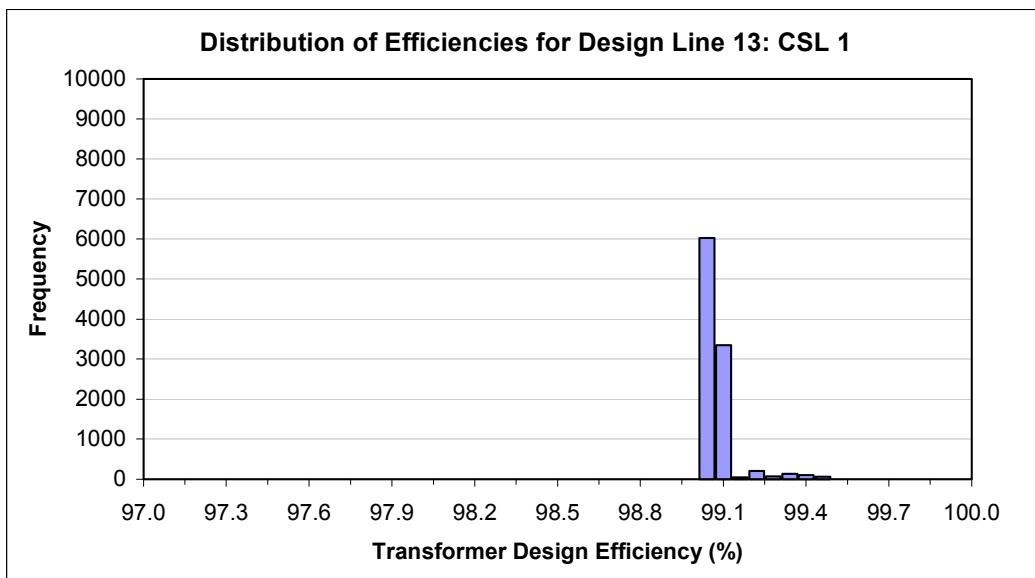


Figure 8E.4.74

Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 1

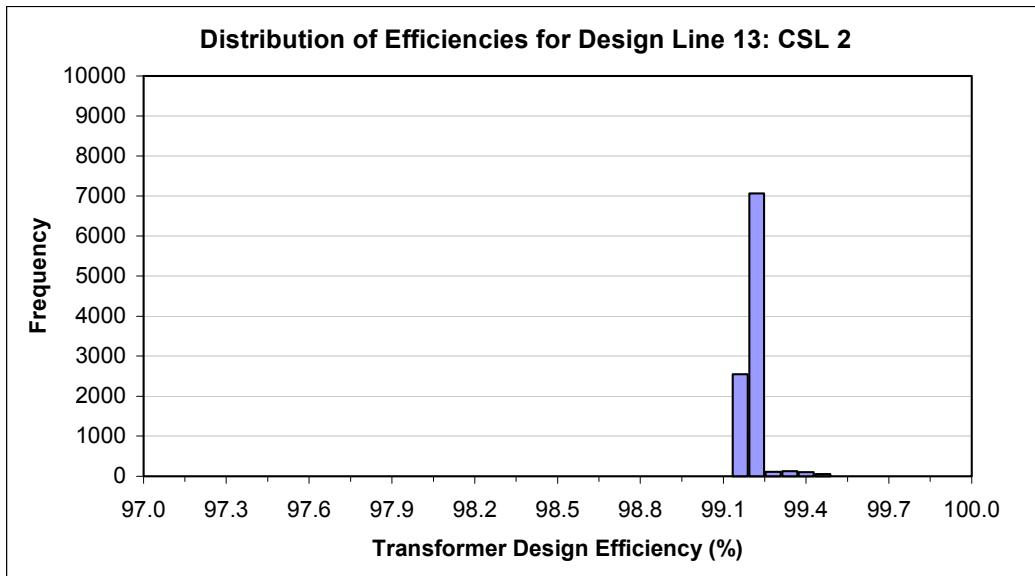


Figure 8E.4.75

Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 2

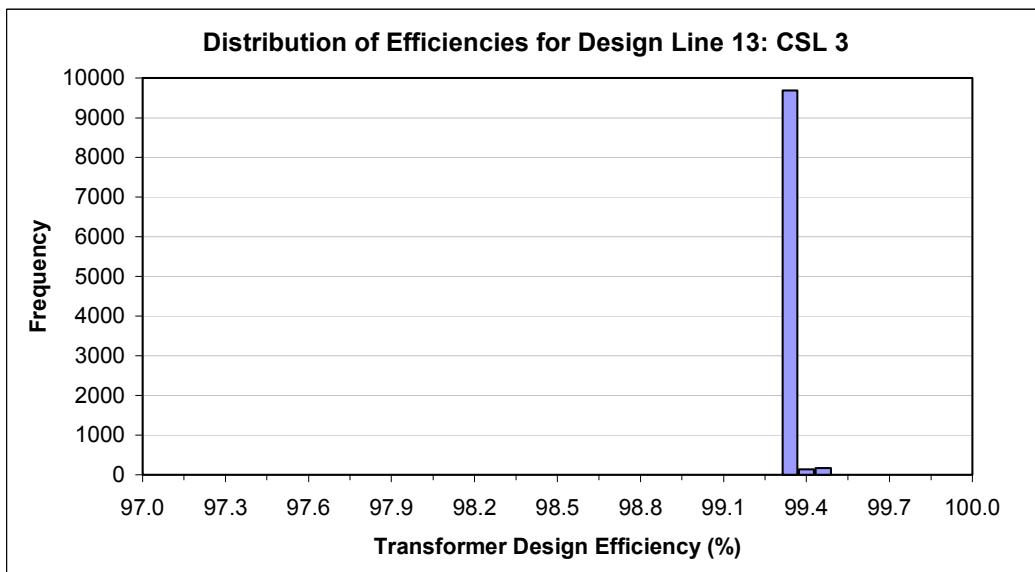


Figure 8E.4.76

Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 3

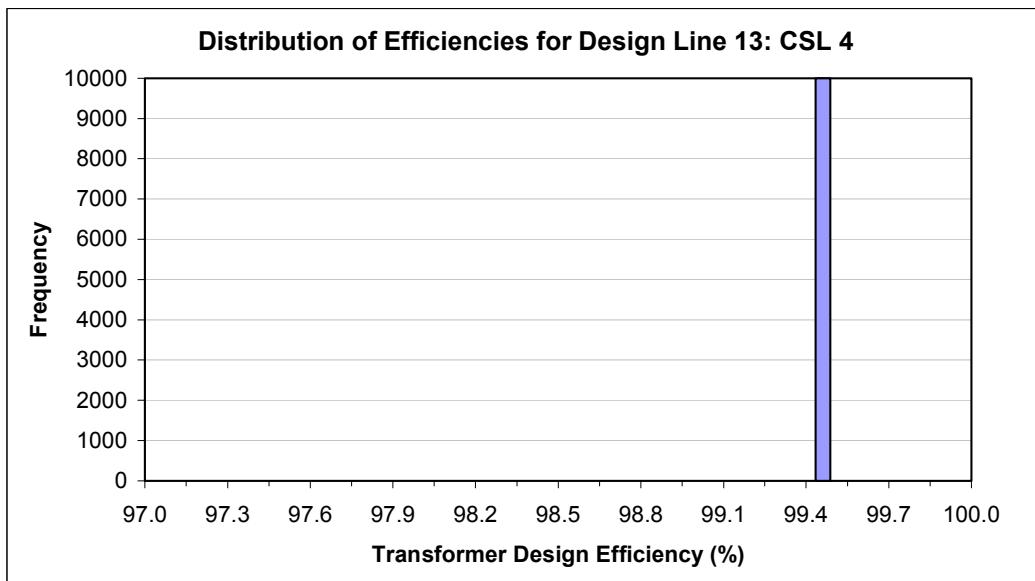


Figure 8E.4.77 Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 4

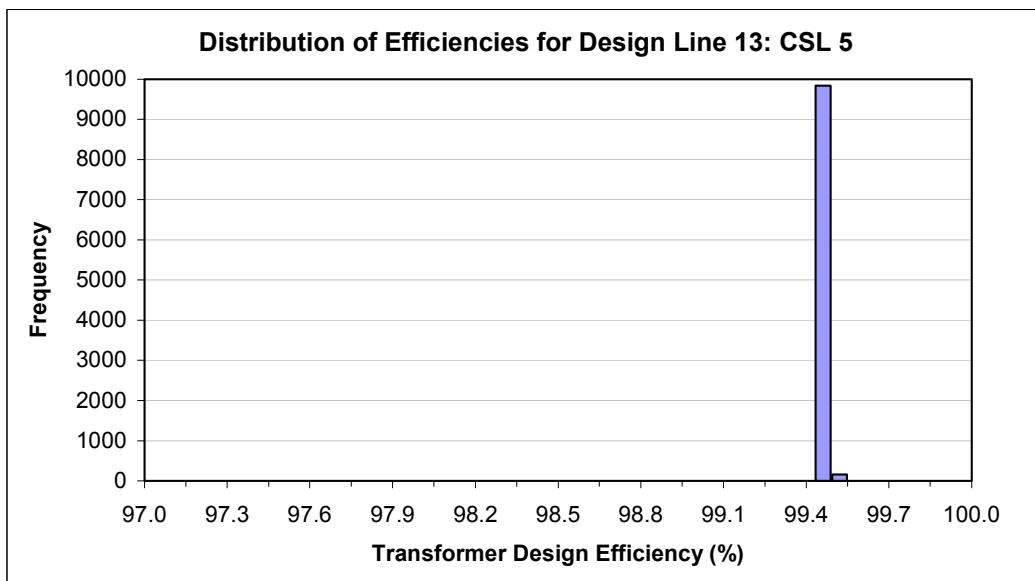


Figure 8E.4.78 Distribution of Efficiencies for Design Line 13 Representative Unit, CSL 5